LIGHT GUIDE PLATE AND SURFACE LIGHT SOURCE DEVICE

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Abstract

PROBLEM TO BE SOLVED: To lessen influence of a displacement of a point light source to a light incoming part, by providing plural small holes or grooves ranging to an external part in the vicinity of the light incoming part, and by diffusing and reflecting the introduced light inward in the boundary of the small hole or groove.

SOLUTION: Longitudinal stripes 30 are provided on a light incoming part 24 facing a point light source and areas on its both sides. Thereby, light (f) incoming into a light guide plate 22 from the light incoming part 24 and its periphery is directed toward the corner part of the photo-conductive plate 22 by the light incoming part 24, and is also diffused on a parallel plane to a light outgoing emission surface by the longitudinal stripes 30. The longitudinal stripes 30 provided on both sides of the light incoming part 24 also introduce light from the point light source into the light guide plate 22 without being totally reflected. Accordingly, light utilization efficiency can be enhanced by a surface light source device using this type of light guide plate 22. In addition, luminance distribution on the light outgoing emission surface can be uniformed, and particularly the corner of the light guide plate 22 is prevented from darkening.

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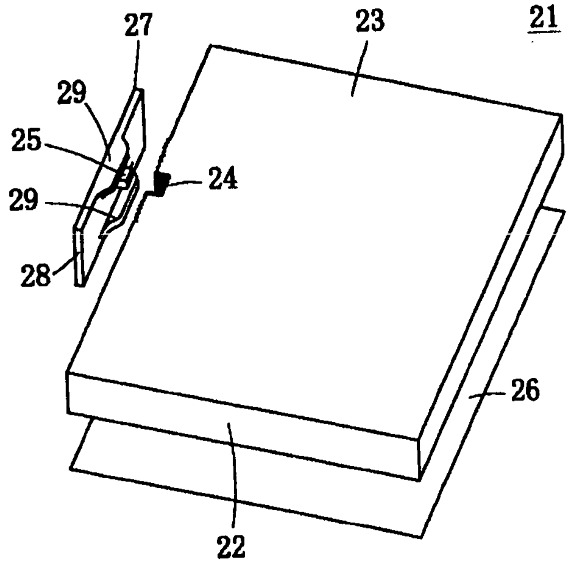
(54)【発明の名称】 導光板及び面光源装置

(57)【要約】
【課題】 導光板の光入射面に凹状の光入射部を形成された面光源装置において、光入射部に対する点光源の位置ずれの影響を小さくすることにある。
【解決手段】 導光板２２の、点光源２５と対向する側面に凹状の光入射部２４を形成し、光入射部２４及びその両側の領域に、光出射面２３と垂直な方向に延びた細かな縦筋３０を形成し、導光板２２に導入された光を縦筋３０によって拡散させる。



【特許請求の範囲】

【請求項１】　光入射部から導入した光を内部で広げて光出射面から面状に出射する導光板において、
外部に連なる複数の小孔又は溝を前記光入射部の近傍に設け、導入した光を前記小孔または溝との境界で内部方向へ拡散反射させることを特徴とする導光板。

【請求項２】　略直方体状の透明平板の面積の大きい面を光出射面とし、面積の小さい面に光入射部を設け、前記光出射面と反対側の面から前記光出射面に達しない前記小孔をあけ、この小孔を塞ぐようにして前記光出射面と反対側の面のほぼ全体に反射板を固着させた、請求項１に記載の導光板。

【請求項３】　光源と、この光源に対向する光入射部から導入した光を内部で広げて光出射面から面状に出射する導光板とを有する面光源装置において、
外部に連なる複数の小孔又は溝を前記導光板の前記光入射部の近傍に設け、前記導光板に導入した光を前記小孔または溝との境界で前記導光板の内部方向へ拡散反射させることを特徴とする面光源装置。

【請求項４】　光源と、この光源に対向する光入射部から導入した光を内部で広げて光出射面から面状に出射する導光板とを有する面光源装置において、
前記光源の表面に凹凸を形成して前記光入射部から前記導光板内に拡散光を導入することを特徴とする面光源装置。

【請求項５】　光源と、この光源に対向する光入射部から導入した光を内部で広げて光出射面から面状に出射する導光板とを有する面光源装置において、
前記導光板の前記光入射部に光出射面とほぼ垂直な方向に延びた複数の筋目を設け、前記導光板の前記光入射部から導入する光を前記筋目により拡散させることを特徴とする面光源装置。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は導光板及び面光源装置に関する。具体的にいうと、本発明は液晶表示パネルのバックライト等として用いられる面光源装置と、その面光源装置などに用いられる導光板に関する。

【０００２】

【従来の技術】（複数の点光源を用いた面光源装置）従来例の面光源装置１を図１の分解斜視図及び図２の断面図により示す。面光源装置１は、光を閉じ込めるための導光板２と発光部３と反射板４とから構成されている。導光板２はポリカーボネイト樹脂やメタクリル樹脂等の透明で屈折率の高い樹脂により成形されており、導光板２の下面には凹凸加工や拡散反射インクのドット印刷等によって拡散パターン５が形成されている。発光部３は、回路基板６上に複数の発光ダイオード（ＬＥＤ）等のいわゆる点光源７を実装したものであって、導光板２の側面８に対向している。反射板４は、反射率の高い例えば白色樹脂シートによって形成されており、両面テープ９によって両側部を導光板２の下面に貼り付けられている。

【０００３】しかして、図２に示すように、発光部３から出射されて側面８から導光板２の内部に導かれた光ｆは、導光板２内部で全反射することによって導光板２内部に閉じ込められる。導光板２内部の光ｆは拡散パターン５に入射すると拡散反射され、光出射面１０へ向けて全反射の臨界角よりも小さな角度で反射された光ｆが光出射面１０から外部へ取り出される。また、導光板２下面の拡散パターン５の存在しない箇所を透過した光ｆは、反射板４によって反射されて再び導光板２内部へ戻るので、導光板２下面からの光量損失を防止される。

【０００４】一方、点光源７から出射され導光板２に入射した光は、導光板２下面の拡散パターン５で反射することにより、図３に示すように、導光板２内部で広がってゆき、光出射面１０の全体から出射される。

【０００５】複数の点光源を用いた上記のような面光源装置１は、低消費電力化のため、点光源７で疑似的に線状光源化を図ったものであった。すなわち、点光源７を一列に配列することによって冷陰極線管のような線状光源を模したものである。従って、より低消費電力化を図るためには、点光源の数を減らして、好ましくは１つの点光源により高輝度で輝度ばらつきの少ない面光源装置を得ることが望まれる。

【０００６】（１個の点光源を用いた面光源装置）そこで、図４に示すように、導光板２の側面８に１個の発光ダイオードや複数個の局在した発光ダイオードからなる点光源７を配置した面光源装置１１が提案されている。この面光源装置１１では、同心円状に並んだ拡散パターン５を導光板２の下面に設けることによって点光源７からの光ｆを直線的に制御している。また、点光源７からの距離が遠くなるに従って拡散パターン５のパターン密度を高くすることにより、光出射面１０の全体からほぼ均一に光が出射されるようにしている。

【０００７】従って、このような面光源装置１１によれば、図１のような構造の面光源装置１よりも高効率で輝度分布の均一性の高いものが得られる。

【０００８】

【発明が解決しようとする課題】しかしながら、導光板２の光入射側に位置する側面８が平面であると、点光源７から出て側面８に入射する光のうち入射角の小さなものは、図５に示す光線ｆ１ように側面８で全反射され、さらに側面８から導光板２内に入射する光も、図５に示す光線ｆ２のように、側面８に垂直な方向に集まるように屈折する。

【０００９】この結果、図４に示したような構造の面光源装置１１では、導光板２の隅部には光が到達しにくくなり、図６に示すように、導光板の隅部が暗くなる（斜線を施した領域が暗部１２である）。図７は、図６のＡ

１－Ａ２線に沿った輝度分布を示しており、特に側面８の近傍で輝度分布の不均一が発生している。

【００１０】同様に、図１に示したような構造の面光源装置１でも、点光源７から出て導光板２内に入射した光が充分に広がらないので、導光板２の隅部や点光源７間に対応する部分には光が到達しにくく、図８に示すように暗部１２が生じる（斜線を施した領域が暗部１２である）。図9は、図８のＢ１－Ｂ２線に沿った輝度分布を示しており、側面８の近傍では暗部と明部が交互に分布しており、輝度分布が不均一になっている。

【００１１】そこで、図１０又は図１１に示す面光源装置１１，１のように、点光源７に対向させて導光板２に凹状の光入射部１３を設けたものがある。このように点光源７に対向させて導光板２に凹状の光入射部１３を設けると、図１２に示すように、光入射部１３が無ければ導光板２の側面８で全反射される光も光入射部１３から導光板２に取り込むことができ、しかも光入射部１３の側面から入射する光ｆ３は導光板２の隅部へ向かうように屈折されるので、導光板２の隅部へ光を送って暗くなるのを防止することができる。この結果、図１３に示す輝度分布のように、点光源７の近傍でも、輝度分布を均一にすることができる。

【００１２】ここで、導光板内で必要な光を考えた場合、必要な光量は点光源を中心とする方向によって異なる。例えば、図１４に示すように、対角方向では導光板の縁までの距離がもっとも大きくなるから、この方向にはもっとも多くの光量を分配する必要がある。これに対し、光入射部１３が設けられている側面８と平行な方向には、分配される光量は少なくてもよい。詳しくは、光出射面１０の輝度は、
輝度＝ｋ×（拡散パターンの拡散密度）×（光量）
ただし、ｋは比例定数
で表されるから、光出射面１０の全体で輝度が均一となるように拡散パターンのパターン密度と光量の分布が決定される。従って、光入射部１３の設けられている側面８に垂直な方向を０゜とした時の、理想的な光量分布は図１５で示される。ただし、実際には光のロスがあるから、各方向にはこれよりも少し多くの光量が送られる。

【００１３】しかしながら、面光源装置や発光部の組み立て時の誤差等によって、光入射部に対する点光源７の位置が、図１６に破線で示す設計位置から実線で示す位置へずれると、この位置ずれのために図１６及び図１７に破線で示す光線ｆ４が消滅し、図１６及び図１７に実線で示す光線ｆ５が新たに発生することになる。そして、新たに発生した光線ｆ５の方向では光量が増加して輝度が高くなり、消滅した光線ｆ４の方向では光量が不測して輝度が低下するので、導光板２の幅方向（Ｄ１－Ｄ２線）に沿った輝度分布は図１８に示すようになり、点光源７の位置ずれによって輝度分布の不均一が発生し、導光板２に輝度分布のムラが生じる。

【００１４】なお、ここでは点光源が１個の場合を例にとって説明したが、図１の面光源装置のように複数の点光源を用いた場合でも同様な問題がある。ただし、点光源が１個の面光源装置では、導光板内では平面視で光が直進するので、点光源が複数の場合よりも点光源の位置ずれの影響が大きい。

【００１５】本発明は上述の技術的問題点を解決するためになされたものであり、その目的とするところは、導光板の光入射面に光入射部を形成された面光源装置において、光入射部に対する点光源の位置ずれの影響を小さくすることにある。

【００１６】

【発明の開示】請求項１に記載の導光板は、光入射部から導入した光を内部で広げて光出射面から面状に出射する導光板において、外部に連なる複数の小孔又は溝を前記光入射部近傍に設け、導入した光を前記小孔または溝との境界で内部方向へ拡散反射させることを特徴としている。

【００１７】請求項１に記載した導光板にあっては、光入射部から導入した光を拡散反射させる小孔または溝を導光板の光入射部近傍に設けているので、光入射部から導光板内に導入された光は小孔または溝によって拡散反射される。この結果、光入射部に入射する光線方向が変化しても、光線方向の変化による輝度分布の変化が均一化され、輝度ムラの発生が抑制される。よって、導光板に導入される光線の方向が設計値と異なっても輝度分布を均一に保つことができる。

【００１８】請求項２に記載の実施態様は、請求項１に記載の導光板において、略直方体状の透明平板の面積の大きい面を光出射面とし、面積の小さい面に光入射部を設け、前記光出射面と反対側の面から前記光出射面に達しない前記小孔をあけ、この小孔を塞ぐようにして前記光出射面と反対側の面のほぼ全体に反射板を固着させたことを特徴としている。

【００１９】請求項２の実施態様は導光板に小孔を設けた場合であって、小孔の先端と光出射面との間には隙間があるので、この隙間を通過して光が小孔の背後に達することができ、また小孔の開口端に反射板が対向しているので、小孔の開口端から出た光が反射板で反射して小孔の背後に達することができる。従って、導光板に小孔を設けても、小孔の背後に影が生じるのを防止することができる。

【００２０】請求項３に記載の面光源装置は、光源と、この光源に対向する光入射部から導入した光を内部で広げて光出射面から面状に出射する導光板とを有する面光源装置において、外部に連なる複数の小孔又は溝を前記導光板の前記光入射部の近傍に設け、前記導光板に導入した光を前記小孔または溝との境界で前記導光板の内部方向へ拡散反射させることを特徴としている。

【００２１】請求項３に記載した面光源装置にあって

は、光入射部から導入した光を拡散反射させる小孔または溝を導光板の光入射部近傍に設けているので、光入射部から導光板内に導入された光は小孔または溝によって拡散反射される。この結果、光入射部に対する光源の位置がずれても、光源の位置ずれによる輝度分布の変化が均一化され、輝度ムラの発生が抑制される。よって、光源の位置が設計位置からずれても輝度分布を均一に保つことができる。

【００２２】請求項４に記載の面光源装置は、光源と、この光源に対向する光入射部から導入した光を内部で広げて光出射面から面状に出射する導光板とを有する面光源装置において、前記光源の表面に凹凸を形成して前記光入射部から前記導光板内に拡散光を導入することを特徴としている。

【００２３】請求項４に記載した面光源装置にあっては、光源の表面に凹凸を設けているので、導光板に導入される光は光源から出射される際に拡散される。この結果、光入射部に対する光源の位置がずれても、光源の位置ずれによる輝度分布の変化が均一化され、輝度ムラの発生が抑制される。よって、光源の位置が設計位置からずれても輝度分布を均一に保つことができる。

【００２４】請求項５に記載の面光源装置は、光源と、この光源に対向する光入射部から導入した光を内部で広げて光出射面から面状に出射する導光板とを有する面光源装置において、前記導光板の前記光入射部に光出射面とほぼ垂直な方向に延びた複数の筋目を設け、前記導光板の前記光入射部から導入する光を前記筋目により拡散させることを特徴としている。ここで、筋目とは、細い筋状の凹凸であって、本明細書でいう溝には、筋目も含まれる。

【００２５】請求項５に記載した面光源装置にあっては、光入射部から導入する光を拡散させる筋目を光入射部に設けているので、光入射部から導光板内に導入される光は筋目によって拡散される。この結果、光入射部に対する光源の位置がずれても、光源の位置ずれによる輝度分布の変化が均一化され、輝度ムラの発生が抑制される。よって、光源の位置が設計位置からずれても輝度分布を均一に保つことができる。

【００２６】

【発明の実施の形態】（第１の実施形態）図１９は本発明の一実施形態による面光源装置２１の構造を示す分解斜視図である。導光板２２は屈折率の大きな透明樹脂材料によって形成されており、導光板２２の上面が光出射面２３となっている。導光板２２の下面には凹凸加工や拡散反射インクのドット印刷等によって拡散パターン３３が形成されている。この拡散パターン３３は、導光板２２の光入射部２４に対向させて配置される点光源２５を中心として同心円状に配列されており、点光源２５からの距離が大きくなるに従って拡散パターン３３のパターン密度が次第に大きくなっている（図２４、図４参照）。また、導光板２２の下面には、白色プラスチックシートのような表面反射率の高い材料によって形成された反射板２６が両面テープ等によって貼り付けられている。

【００２７】導光板２２の側面のうち、点光源２５と対向する位置には、点光源２５よりも少し大きな光入射部２４が凹設されている。この光入射部２４の内面とその両側の領域には、図２０に示すように、光出射面２３と垂直な方向に延びた細かな縦筋（筋目）３０が一様に形成されている。この縦筋３０は、導光板２２を成型するための成型金型に縦筋３０を設けておき、導光板２２の成型時に成型金型の縦筋３０が導光板２２に転写されるようにすればよい。あるいは、成型された導光板２２の光入射部２４及びその両側の領域に透明な紫外線硬化樹脂（ＵＶ樹脂）を塗布し、スタンパにより紫外線硬化樹脂に縦溝を転写すると共に紫外線を照射して硬化させるようにしてもよい（PhotoPolymerization法）。

【００２８】発光部２７は、白色樹脂等の表面反射率の高い材質からなる実装部材２８に、発光ダイオードや豆電球等の点光源２５（導光板２２に比べて小さな光源）を取り付けたものである。また、点光源２５の上方及び下方では、実装部材２８の上縁及び下縁からカバー部２９が延出されている。カバー部２９は導光板２２に凹設された光入射部２４にはまり込むようになっており、点光源２５と導光板２２の間の隙間から上方及び下方へ光が漏れるのを防止している。

【００２９】このように点光源２５と対向する、光入射部２４及びその両側の領域に縦筋３０を設けていると、光入射部２４ないしその周辺から導光板２２内に入射する光ｆは、光入射部２４によって導光板２２の隅部へ向かう方向へ向かわせられ、さらに、図２０に示すように縦筋３０によって光出射面２３と平行な面内で拡散される。また、光入射部２４両側に設けられている縦筋３０は、点光源２５の光を全反射させることなく、導光板２２内部に導く。従って、このような導光板２２を用いた面光源装置２１によれば、光の利用効率を高くすると共に光出射面２３における輝度分布を均一化することができ、特に導光板２２の隅部が暗くなるのを防止できる。

【００３０】図２１は点光源２５が設計位置からずれた時のようすを示している。点光源２５の設計位置を破線で示し、誤差等により位置ずれした点光源２５の位置を実線で示す。また、点光源２５が位置ずれしたことによって発生する光ｆ６を実線で示し、位置ずれによって消滅する光ｆ７を破線で表わしている。この面光源装置２１では、光入射部２４とその近傍に縦筋３０を設けているから、点光源２５の位置ずれによって発生した光ｆ６や消滅する光ｆ７は縦筋３０を通過することによって拡散され、縦筋３０がない時と比べると図２１又は図２２に示すように拡がりをもって進む。このため、点光源２５の位置ずれの影響が分散、平均化されて、光出射面２

３の幅方向に沿った輝度分布は図２３に実線カーブ３１で示すように平均化され（図２３の破線カーブ３２は縦筋３０がない場合の輝度分布）、輝度ムラが目立たなくなる。

【００３１】これに対し、光入射部２４を設けられた側面と垂直な導光板断面においては、図２４に示すように、導光板２２に入射する光ｆは縦筋３０によって拡散されないので、光入射部２４の近傍から多量の光が漏れて光のロスとなったり、局部的な明点が生じたりすることが抑制される。

【００３２】上記実施形態では、１個の点光源２５の場合について説明したが、この実施形態は、図２５に示すように、複数の点光源２５を備えた発光部２７を用いた場合にも適用することができる。この面光源装置３４のように、各点光源２５に対向させて導光板２２に設けた光入射部２４とその両側の領域にそれぞれ縦筋３０を設けても、光の利用効率を高めると共に輝度分布の不均一を小さくすることができ、さらに点光源２５の位置がずれても輝度ムラが生じにくくなる。

【００３３】（第２の実施形態）図２６は本発明の別な実施形態による導光板２２の光入射部２４の近傍を拡大して示す一部破断した平面図である。この実施形態にあっては、光入射部２４及びその両側の領域において、縦筋３０を間欠的に形成することにより、縦筋３０間に平面部分３５を設けている。また、図２７に示す実施形態では、導光板２２の光入射部２４及びその両側の領域において、縦筋３０を複数本連続的形成すると共に集合した縦筋３０間に平面部分３５を設けている。

【００３４】縦筋３０を通過した光は拡散するのに対し、縦筋３０間の平面部分３５を通過した光は広がらないので、これらの実施形態によれば、縦筋３０の領域と縦筋３０間の平面部分３５の割合変えることにより、導光板２２内に入射した光の拡散量を調整することができる。

【００３５】（第３の実施形態）図２８は本発明のさらに別な実施形態による面光源装置４１の構造を示す分解斜視図、図２９はその導光板２２の光入射部２４の近傍の構造を示す一部破断した拡大斜視図である。この面光源装置４１にあっては、導光板２２の光入射部２４周辺において、光入射部２４を囲むようにして複数の小孔４２を設けてある。各小孔４２は、円柱状をしていて光出射面２３と垂直に設け設けられており、光出射面２３及びその反対側の面４３に貫通している。ただし、各小孔４２は、図３０に示すように、導光板２２の拡散パターン３３の領域外の非有効領域（例えば、液晶表示パネルのバックライトとして用いる場合の、非表示面と対向する領域）に設けるのが望ましい。

【００３６】このように光入射部２４の周囲に小孔４２を設けると、光入射部２４から導光板２２内に入射した光ｆが小孔４２とその内部の空間との界面で屈折又は全反射されることにより、図２９に示すように小孔４２に当たった光ｆは小孔４２で拡散される。この結果、この小孔４２によって第１の実施形態における縦筋３０と同様な作用効果を納めることができる。すなわち、光入射部２４から導光板２２内に入射した光ｆが小孔４２で拡散されることにより、導光板２２の隅部にも光が達するようになり、導光板２２の隅部が暗くなるのを防止できる。しかも、小孔４２は光出射面２３と垂直な方向を向いているので、小孔４２に当たった光ｆは上下方向には拡散されることがなく、小孔４２の近傍で局所的な明部が生じることがない。さらに、光入射部２４から入射した光ｆを小孔４２によって拡散させることにより、光入射部２４に対する点光源２５の位置ずれの影響で輝度ムラが生じるのを防止することができる。

【００３７】また、小孔４２の断面形状は点光源２５からの光が来る方向に長く、それと直交する方向に短くなるようにすれば、小孔４２による光の拡散効果を大きくすることができる。例えば、図３１に示すように、小孔４２の断面形状を長円状とし、その長円の長軸方向が点光源２５からの光ｆが来る方向と平行になるようにしてもよい。このようにすれば、小孔４２内への光の進入を抑えることができ、点光源２５から来た光に対する小孔４２の側面の角度が大きくなり、光が小孔４２で反射される確率が高くなる。よって、小孔４２による拡散効果を高くすることができる。

【００３８】さらには、図３２に示すように、小孔４２の断面形状をくさび形とし、点光源２５から来る光ｆの方向にくさび形の先端を向けるようにすれば、小孔４２内への光の進入を抑制し、小孔４２による反射率を大きくし、小孔４２による拡散効果をより一層高くすることができる。

【００３９】なお、この実施形態でも、１個の点光源２５の場合について説明したが、この実施形態は、図３３に示すように、複数の点光源２５を備えた発光部２７を用いた面光源装置４４にも適用することができる。

【００４０】（第４の実施形態）図３４及び図３５は本発明のさらに別な実施形態による小孔４２の構造を示す、導光板２２の一部破断した拡大断面図である。この実施形態では、導光板２２の光入射部２４の周囲に設けられた複数の小孔４２は、いずれも光出射面２３と反対側の面４３で開口しているが、光出射面２３には達していない。

【００４１】第３の実施形態で述べたような上下に貫通した小孔４２では、小孔４２の背後（点光源２５と反対側）に影が生じて暗部となる恐れがあるが、この実施形態のように小孔４２が光出射面２３に達しておらず、小孔４２の上端と光出射面２３との間に隙間があると、図３４に示すように、導光板２２に入射した光ｆがこの隙間を通って小孔４２の背後に達する。さらに、小孔４２は光出射面２３と反対側の面４３で開口しているので、

図３５に示すように、小孔４２の下面開口から出た光ｆは、導光板２２の下面に固着されている反射板２６で反射されて小孔４２の背後で導光板２２内部に戻る。従って、この実施形態によれば、小孔４２の背後に影ができて暗くなるのを防止することができる。

【００４２】また、この実施形態では、小孔４２の高さや小孔４２どうしの間隔を調整することにより、光の拡散量を調整することもできる。

【００４３】しかし、小孔４２の断面形状が上から下までほぼ同一であると、光出射面２３と反対側の面で小孔４２を開口させても、図３６に示すように小孔４２の界面で屈折することにより、あるいは小孔４２の下面開口で反射板２６により反射されることにより、小孔４２の上面から多少光ｆが漏れ、光出射面２３へ抜ける。これを防止するためには、図３７に示すように、小孔４２の断面が光出射面２３に近づくほど小さくなるようにし、例えば小孔４２を円錐状にして小孔４２の上面を無くせば、小孔４２を通った光ｆをすべて導光板２２内に閉じ込めることができ、小孔４２の上方で光ｆが光出射面２３へ漏れて輝度ムラとなるのを防止できる。

【００４４】（第５の実施形態）図３８は本発明のさらに別な実施形態による面光源装置５１の分解斜視図である。この面光源装置５１にあっては、光入射部２４の周囲において導光板２２の上面、下面あるいは上下両面に複数の溝５２を凹設している。図３９に示すように、溝５２は、それぞれの長さ方向が平面視で光源から来る光ｆの方向と平行となるように略放射状に形成されている。さらに、各溝５２は、図４０に示すように、かまぼこ形に形成されている。しかして、点光源２５から出射された光ｆが光入射部２４から導光板２２内に進入して溝５２に当たると、溝５２で反射されることによって様々な方向へ拡散反射される。この結果、光ｆを導光板２２内で均一に分散させることができ、面光源装置５１の輝度ムラを小さくできる。特に、点光源２５が誤差により光入射部２４に対して位置ずれしていても輝度ムラが発生しにくくなる。また、溝５２は、光の進む方向と平行になっており、各光ｆはその進行方向と直交する方向へのみ拡散されので、拡散パターンの設計も容易に行える。さらに、溝５２の大きさ、深さ、長さ、密度などを調整すれば、溝５２による光の拡散度合いも調整することができる。なお、この溝５２としては、縦筋として示したような微細な線状の凹凸であってもよい。

【００４５】また、この実施形態は、図４１に示すように、複数の点光源２５と複数の光入射部２４を設けられた面光源装置５３にも適用できる。

【００４６】（第６の実施形態）図４２は本発明のさらに別な実施形態による面光源装置６１の一部を判断して示す分解斜視図である。この面光源装置５１にあっては、点光源２５の表面に凹凸を形成している。すなわち、図４３に示すように、点光源２５は、ＬＥＤチップのような発光チップ６３を透明モールド樹脂６４によって成形されており、このモールド樹脂６４の表面には、拡散パターン６２が形成されている。この拡散パターン６２としては、図示例ではカバー部２９と垂直な方向に延びた凹凸条６２を表わしているが、線状である必要はなく、単に光を拡散できればよい。点光源２５の上下にはカバー部２９を設けているので、光が上方もしくは下方へ漏れてロスになることがなく、よって拡散パターン６２は梨地状のものでもよい。

【００４７】図４３は発光チップ６３が設計位置からずれた時のようすを示している。発光チップ６３の設計位置を破線で示し、誤差等により位置ずれした点光源２０の位置を実線で示す。また、点光源２５が位置ずれしたことによって発生する光ｆ６を実線で示し、位置ずれによって消滅する光ｆ７を破線で表わしている。この面光源装置６１では、点光源２５に拡散パターン６２を設けているから、発光チップ６３の位置ずれによって発生した光ｆ６や消滅する光ｆ７は拡散パターン６２を通過することによって拡散されて光入射部２４へ入射する。このため、発光チップ６３の位置ずれの影響が分散、平均化されて輝度ムラが目立たなくなる。

【図面の簡単な説明】

【図１】従来の面光源装置を示す分解斜視図である。

【図２】同上の導光板内における光の挙動を示す断面図である。

【図３】同上の導光板内における光の挙動を示す平面図である。

【図４】従来の別な面光源装置を示す平面図である。

【図５】光入射部における光の挙動を示す図である。

【図６】同上の面光源装置の暗部を示す図である。

【図７】同上の導光板のＡ１−Ａ２線に沿った輝度分布を示す図である。

【図８】複数の点光源を備えた従来のさらに別な面光源装置の暗部を示す図である。

【図９】同上の面光源装置のＢ１−Ｂ２線に沿った輝度分布をを示す図である。

【図１０】従来のさらに別な面光源装置を示す図である。

【図１１】従来のさらに別な面光源装置を示す図である。

【図１２】図１０又は図１１の面光源装置の光入射部の拡大平面図である。

【図１３】図１０の面光源装置のＣ１−Ｃ２線に沿った輝度分布を示す図である。

【図１４】凹状の光入射部を設けた導光板における光の分配の仕方を説明する図である。

【図１５】光の方向と光量との関係を示す図である。

【図１６】点光源の位置がずれたときの光線の挙動の変化を示す図である。

【図１７】点光源の位置がずれたときの光線の挙動の変

化を示す図である。

【図18】図17のD1－D2線に沿った輝度分布を示す図である。

【図19】本発明の一実施形態による面光源装置を示す分解斜視図である。

【図20】光入射部に設けた縦筋を示す拡大斜視図である。

【図21】同上の面光源装置において、点光源の位置がずれた時の光の挙動の変化を示す図である。

【図22】同上の面光源装置において、点光源の位置がずれた時の光の挙動の変化を示す図である。

【図23】同上の面光源装置の幅方向に沿った輝度分布を示す図である。

【図24】導光板内における光の挙動を示す断面図である。

【図25】本発明の別な実施形態による面光源装置を示す分解斜視図である。

【図26】本発明のさらに別な実施形態において、光入射部に設けられた縦筋と平面部分を示す一部破断した平面図である。

【図27】本発明のさらに別な実施形態において、光入射部に設けられた縦筋と平面部分を示す一部破断した平面図である。

【図28】本発明のさらに別な実施形態による面光源装置を示す分解斜視図である。

【図29】光入射部の近傍に設けた小孔を示す拡大斜視図である。

【図30】同上の実施形態における導光板の平面図である。

【図31】本発明のさらに別な実施形態において、光入射部近傍に設けられた別な形状の小孔を示す一部破断した平面図である。

【図32】本発明のさらに別な実施形態において、光入射部近傍に設けられた別な形状の小孔を示す一部破断した平面図である。

【図33】本発明のさらに別な実施形態による面光源装置を示す分解斜視図である。

【図34】本発明のさらに別な実施形態における小孔の形状を示す断面図である。

【図35】同上の実施形態の作用説明図である。

【図36】同上の小孔の問題点を説明する図である。

【図37】本発明のさらに別な実施形態における小孔の形状を示す断面図である。

【図38】本発明のさらに別な実施形態による面光源装置を示す分解斜視図である。

【図39】光入射部の近傍に設けた溝を示す拡大平面図である。

【図40】光入射部の近傍に設けた溝を示す拡大斜視図である。

【図41】本発明のさらに別な実施形態による面光源装置を示す分解斜視図である。

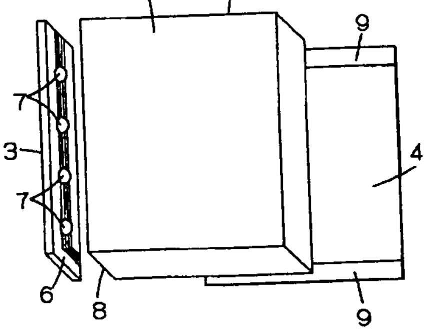
【図42】本発明のさらに別な実施形態による面光源装置を示す一部破断した分解斜視図である。

【図43】同上の面光源装置において、点光源の位置がずれた時の光の挙動の変化を示す図である。

【符号の説明】

22	導光板
23	光出射面
24	光入射部
25	点光源
26	反射板
27	発光部
30	縦筋
35	平面部分
42	小孔
52	溝
62	拡散パターン

【図1】



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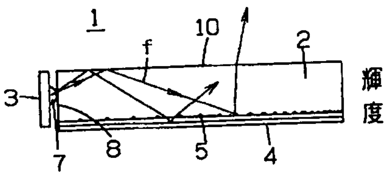

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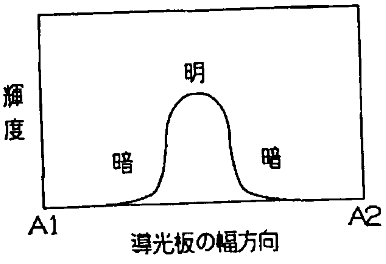

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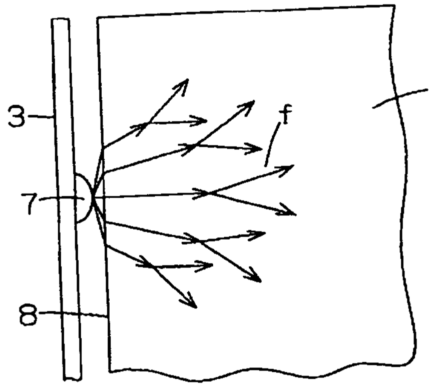

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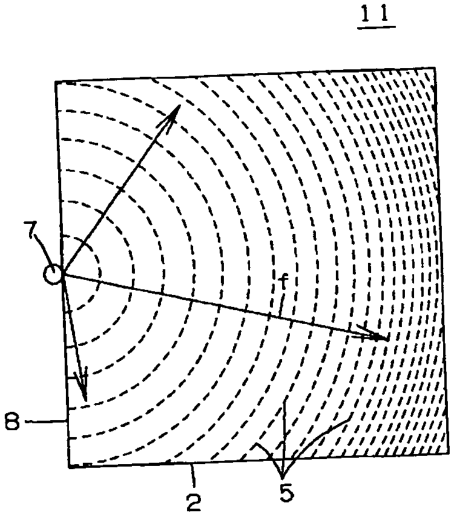

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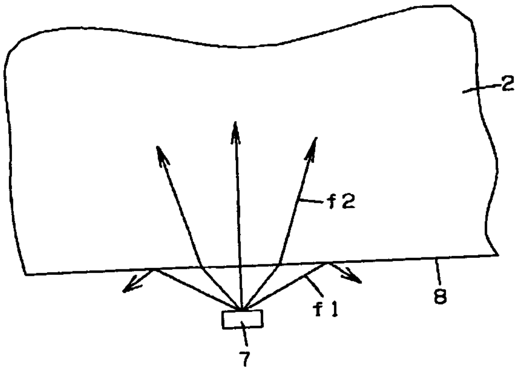

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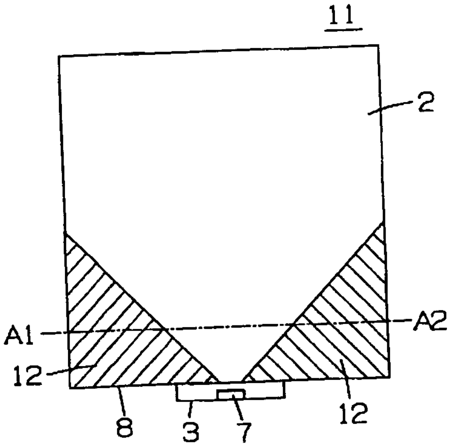

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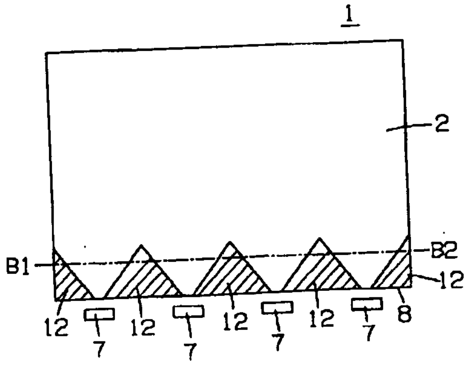

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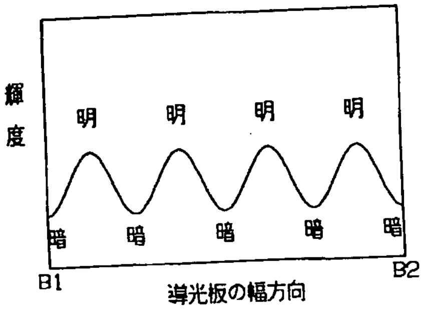

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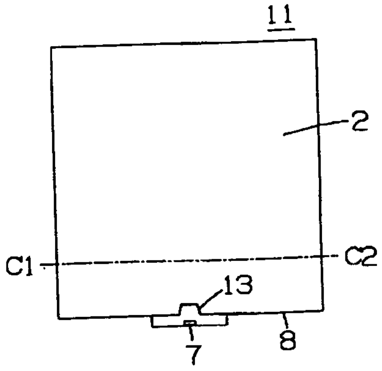

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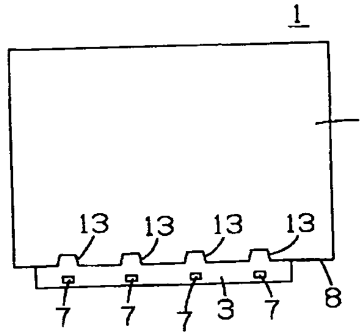

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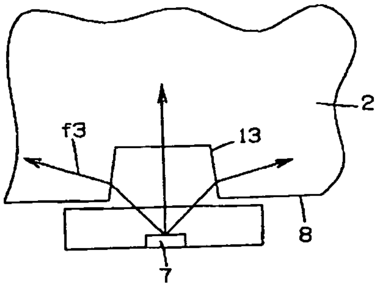

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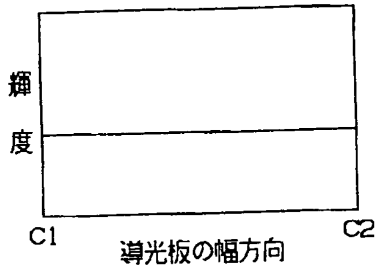

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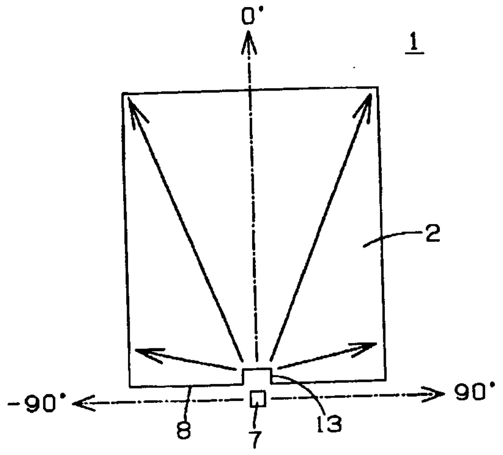

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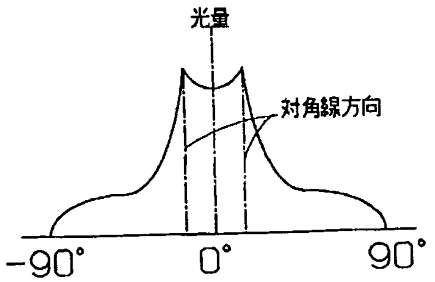

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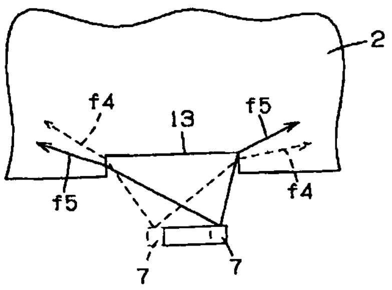

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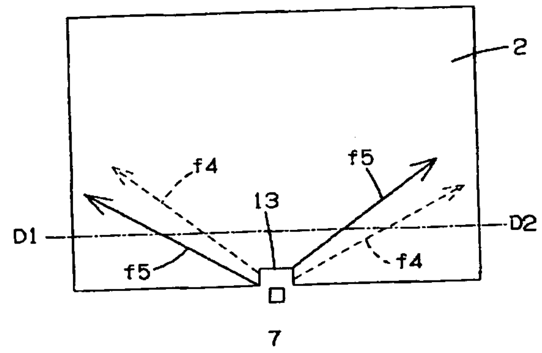

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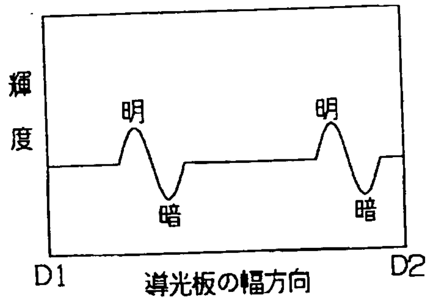

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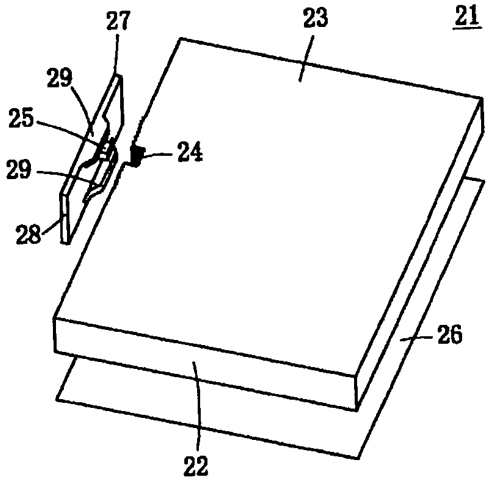

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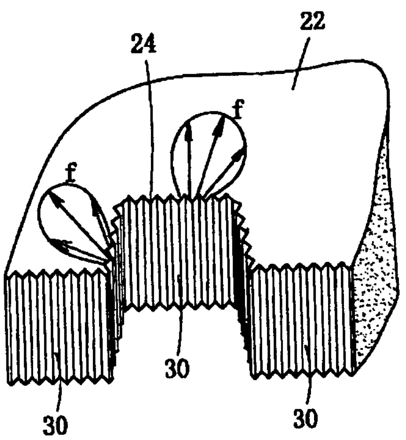

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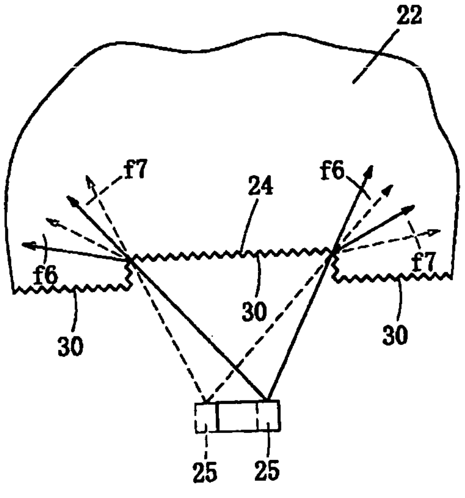

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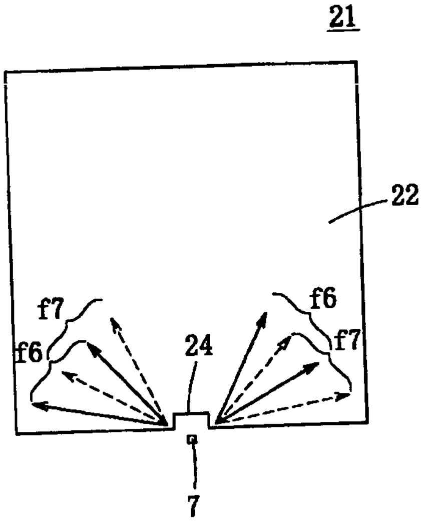

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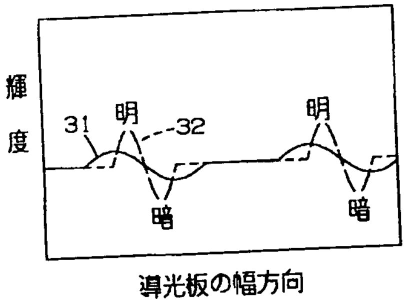

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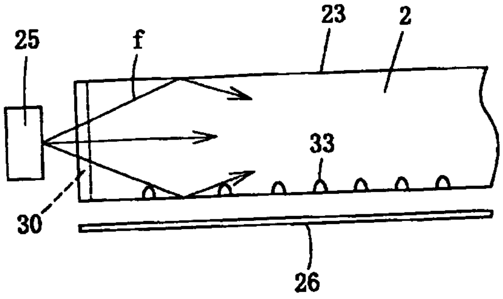

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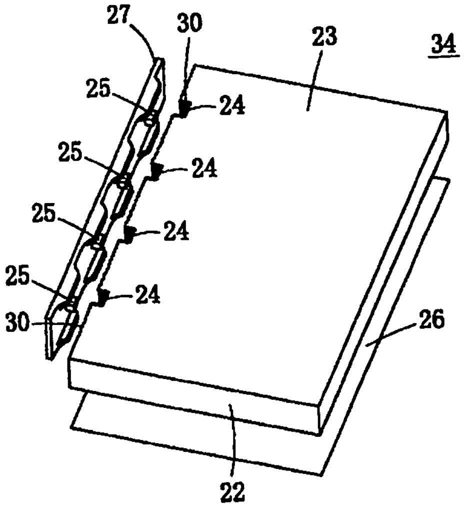

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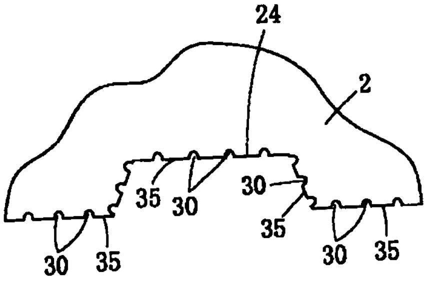

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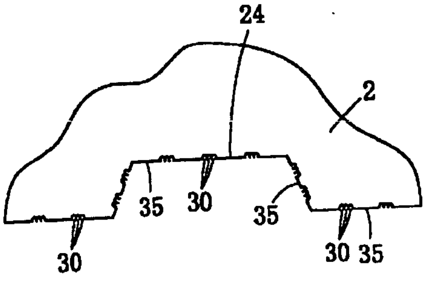

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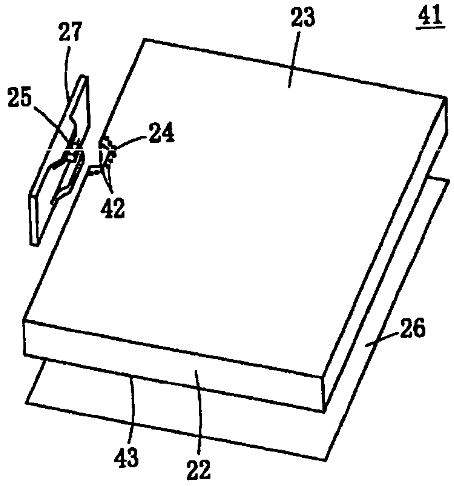

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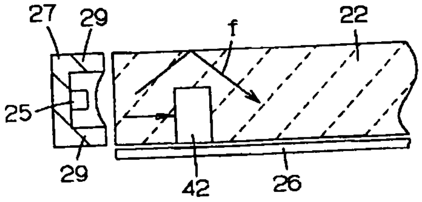

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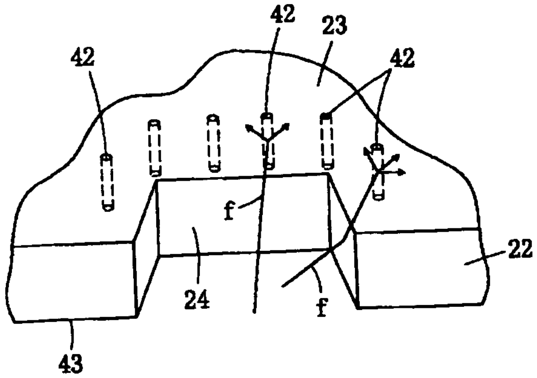

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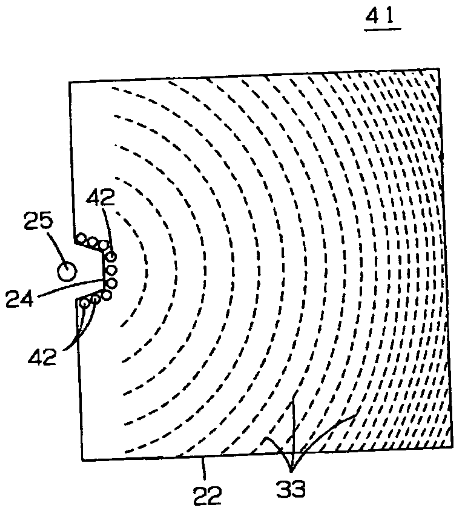

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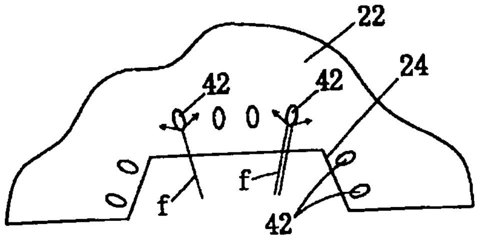

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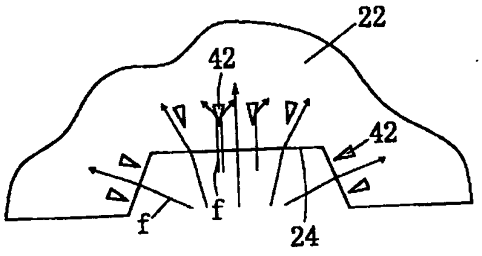

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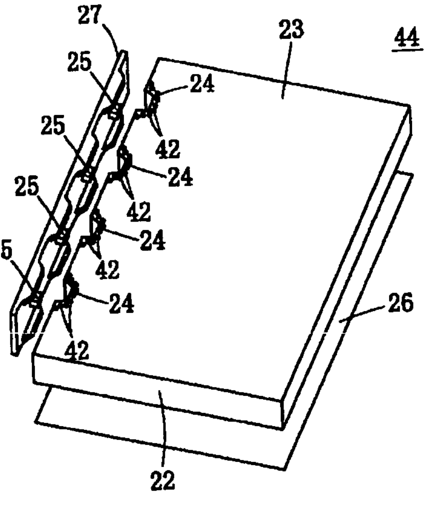

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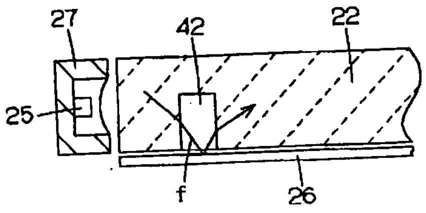

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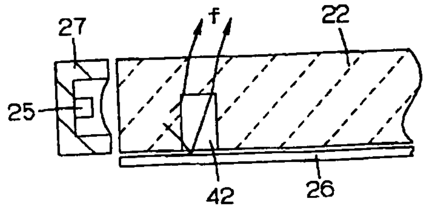

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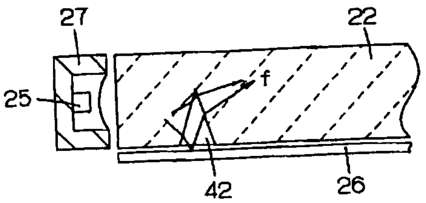

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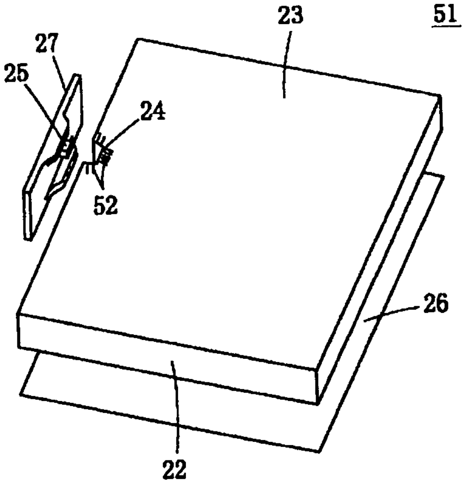

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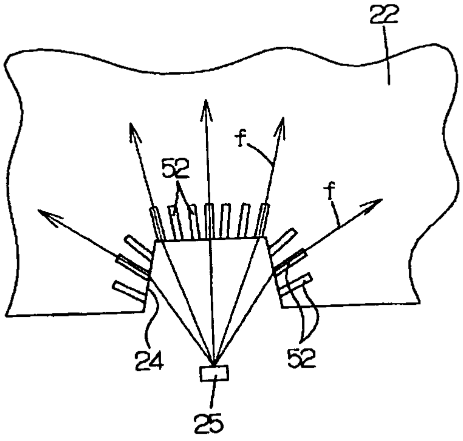

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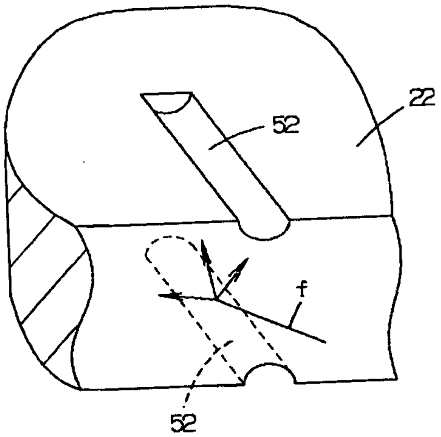

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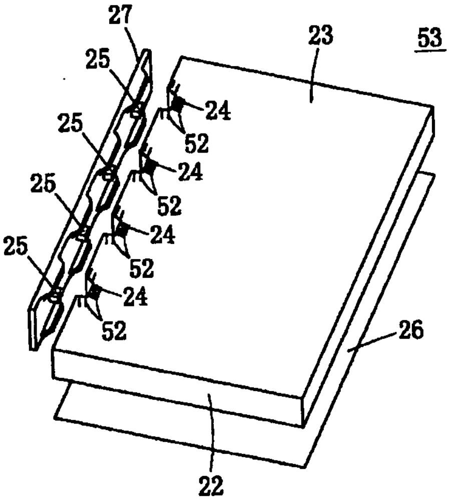

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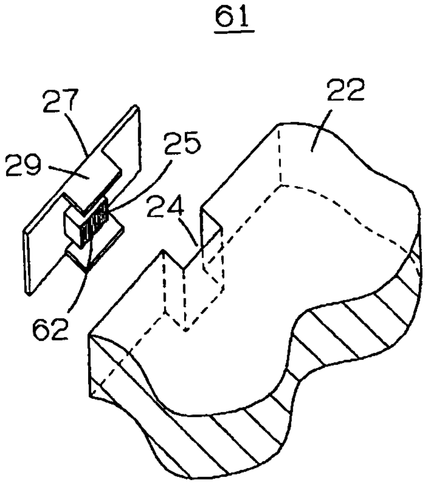

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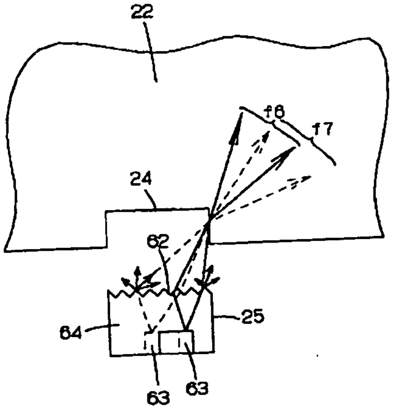

PATENT ABSTRACTS OF JAPAN

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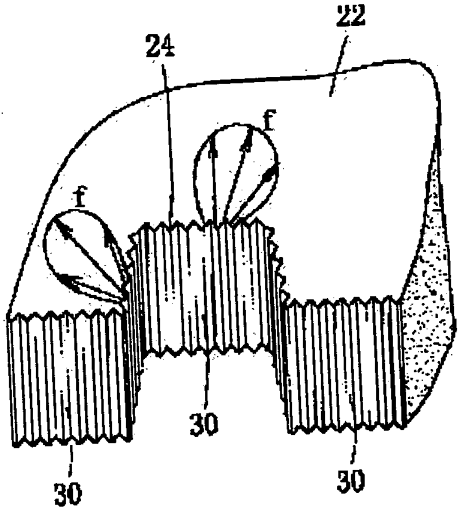
(71)Applicant : OMRON CORP
(72)Inventor : FUNAMOTO AKIHIRO
SHINOHARA MASAYUKI
AOYAMA SHIGERU

(54) LIGHT GUIDE PLATE AND SURFACE LIGHT SOURCE DEVICE

(57)Abstract:



PROBLEM TO BE SOLVED: To lessen influence of a displacement of a point light source to a light incoming part, by providing plural small holes or grooves ranging to an external part in the vicinity of the light incoming part, and by diffusing and reflecting the introduced light inward in the boundary of the small hole or groove.

SOLUTION: Longitudinal stripes 30 are provided on a light incoming part 24 facing a point light source and areas on its both sides. Thereby, light (f) incoming into a light guide plate 22 from the light incoming part 24 and its periphery is directed toward the corner part of the photo-conductive plate 22 by the light incoming part 24, and is also diffused on a parallel plane to a light outgoing emission surface by the longitudinal stripes 30. The longitudinal stripes 30 provided on both sides of the light incoming part 24 also introduce light from the point light source into the light guide plate 22 without being totally reflected. Accordingly, light utilization efficiency can be enhanced by a surface light source device using this type of light guide plate 22. In addition, luminance distribution on the light outgoing emission surface can be uniformed, and particularly the corner of the light guide plate 22 is prevented from darkening.

LEGAL STATUS

[Date of request for examination]

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

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CLAIMS

[Claim(s)]

[Claim 1] The light guide plate which prepares two or more stomata or slots which stand in a row outside near the aforementioned optical incidence section, and is characterized by carrying out diffuse reflection of the introduced light in the direction of the interior on a boundary with the aforementioned stoma or a slot in the light guide plate which extends the light introduced from the optical incidence section inside, and carries out outgoing radiation to the shape of a field from an optical outgoing radiation side.

[Claim 2] As make into an optical outgoing radiation side the field where monotonous abbreviation rectangular parallelepiped-like transparent area is large, the optical incidence section is prepared in the field where area is small, the aforementioned stoma which does not reach the aforementioned optical outgoing radiation side from the aforementioned optical outgoing radiation side and the field of an opposite side is opened and this stoma is closed, it is the light guide plate of the aforementioned optical outgoing radiation side and the field of an opposite side according to claim 1 which made the whole fix a reflecting plate mostly.

[Claim 3] Light source. The light guide plate which extends the light introduced from the optical incidence section which counters this light source inside, and carries out outgoing radiation to the shape of a field from an optical outgoing radiation side. It is surface light source equipment equipped with the above, and two or more stomata or slots which stand in a row outside are prepared near the aforementioned optical incidence section of the aforementioned light guide plate, and it is characterized by carrying out diffuse reflection of the light introduced into the aforementioned light guide plate in the direction of the interior of the aforementioned light guide plate on a boundary with the aforementioned stoma or a slot.

[Claim 4] Surface light source equipment characterized by forming irregularity in the front face of the aforementioned light source, and introducing the diffused light in the aforementioned light guide plate from the aforementioned optical incidence section in the surface light source equipment which has the light source and the light guide plate which extends the light introduced from the optical incidence section which counters this light source inside, and carries out outgoing radiation to the shape of a field from an optical outgoing radiation side.

[Claim 5] The surface light source equipment characterized by to diffuse the light which prepares two or more eyes a line were prolonged in the almost perpendicular direction with an optical outgoing-radiation side in the aforementioned optical incidence section of the aforementioned light guide plate in the surface light source equipment which has the light source and the light guide plate which extends the light introduced from the optical incidence section which counters this light source inside, and carries out outgoing radiation to the shape of a field from an optical outgoing-radiation side, and introduces from the aforementioned optical incidence section of the aforementioned light guide plate by eye the aforementioned line.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[The technical field to which invention belongs] this invention relates to a light guide plate and surface light source equipment. Speaking concretely, this invention's relating to the light guide plate used for the surface light source equipment used as a back light of a liquid crystal display panel etc., its surface light source equipment, etc.

[0002]

[Description of the Prior Art] (Surface light source equipment using two or more point light sources) The decomposition perspective diagram of drawing 1 and the cross section of drawing 2 show the surface light source equipment 1 of the conventional example. Surface light source equipment 1 consists of the light guide plates 2, the light-emitting parts 3, and reflecting plates 4 for shutting up light. The light guide plate 2 is fabricated by transparence, such as polycarbonate resin and methacrylic resin, with the resin with a high refractive index, and the diffusion pattern 5 is formed in the inferior surface of tongue of a light guide plate 2 of concavo-convex processing, dot printing of diffuse reflection ink, etc. The light-emitting part 3 mounted the so-called point light sources 7, such as two or more light emitting diodes (Light Emitting Diode), on the circuit board 6, and has countered the side 8 of a light guide plate 2. The reflecting plate 4 is formed for example, with the white resin sheet with a high reflection factor, and the both-sides section is stuck on it by the double-sided tape 9 on the inferior surface of tongue of a light guide plate 2.

[0003] A deer is carried out, and as shown in drawing 2 , the light f which outgoing radiation was carried out from the light-emitting part 3, and was led to the interior of a light guide plate 2 from the side 8 is confined in the light guide plate 2 interior by carrying out total reflection in the light guide plate 2 interior. If incidence of the light f of the light guide plate 2 interior is carried out to the diffusion pattern 5, diffuse reflection of it will be carried out, and the light f reflected at the angle smaller than the critical angle of total reflection towards the optical outgoing radiation side 10 is taken out in the optical outgoing radiation side 10 shell exterior. Moreover, since it is reflected by the reflecting plate 4 and the light f which penetrated the part where the diffusion pattern 5 of the light guide plate 2 undersurface does not exist returns to the light guide plate 2 interior again, the quantity of light loss from the light guide plate 2 undersurface is prevented.

[0004] By reflecting by the diffusion pattern 5 of light guide plate 2 inferior surface of tongue, as shown in drawing 3 , the light which outgoing radiation was carried out from the point light source 7, and carried out incidence to the light guide plate 2 on the other hand spreads in the light guide plate 2 interior, and outgoing radiation is carried out from the optical whole outgoing radiation side 10.

[0005] the above surface light source equipments 1 using two or more point light sources -- a low-power-izing sake -- the point light source 7 -- false ---like -- a line -- light source-ization was attained namely, the thing for which the point light source 7 is arranged to a single tier -- a line like a cold cathode-ray tube -- the light source is imitated Therefore, in order to attain low-power-ization more, to reduce the number of the point light sources and to obtain surface light source equipment with little brightness dispersion by high brightness by the one point light source preferably is desired.

[0006] (Surface light source equipment using the one point light source) As shown in drawing 4 , the surface light source equipment 11 which has arranged the point light source 7 which becomes the side 8 of a light guide plate 2 from one light emitting diode or two or more light emitting diodes which carried out localization is proposed there. The light f from the point light source 7 is linearly controlled by this surface light source equipment 11 by forming the diffusion pattern 5 located in a line in the shape of a concentric circle in the inferior surface of tongue of a light guide plate 2. Moreover, the outgoing radiation of the light is made to be carried out to homogeneity by making pattern density of the diffusion pattern 5 high mostly from the optical whole outgoing radiation side 10 as the distance from the point light source 7 becomes far.

[0007] Therefore, according to such surface light source equipment 11, it is more efficient than the surface light source equipment 1 of structure like drawing 1 , and the homogeneous high thing of luminance distribution is obtained.

[0008]
[Problem(s) to be Solved by the Invention] however, the beam of light f1 which shows what has a small incident angle to drawing 5 among the light which comes out of the point light source 7 that the side 8 in which it is located in the optical incidence side of a light guide plate 2 is a flat surface, and carries out incidence to the side 8 -- like the beam of light f2 shown in drawing 5 , the light which total reflection is carried out on the side 8 like, and carries out incidence into a light guide plate 2 from the side 8 further is also refracted so that it may gather in the direction perpendicular to the side

[0009] Consequently, with the surface light source equipment 11 of structure as shown in drawing 4 , as light stops being able to arrive at the corner of a light guide plate 2 easily and it is shown in drawing 6 , the corner of a light guide plate becomes dark (the field which gave the slash is dark space 12). Drawing 7 shows the luminance distribution which met A1-A2 line of drawing 6 , and the ununiformity of luminance distribution has generated it especially near the side 8.

[0010] Since the light which similarly came out of the point light source 7, and carried out incidence into the light guide plate 2 also with the surface light source equipment 1 of structure as shown in drawing 1 does not fully spread, light cannot reach the portion corresponding to between the corner of a light guide plate 2, or the point light source 7 easily, and as shown in drawing 8 , dark space 12 arises (the field which gave the slash is dark space 12). Drawing 9 shows the luminance distribution which met the B1-B-2 line of drawing 8 , dark space and the bright section are distributed by turns near the side 8, and luminance distribution is uneven.

[0011] Then, there are some which were made to counter the point light source 7 and formed the concave optical incidence section 13 in the light guide plate 2 like the surface light source equipments 11 and 1 shown in drawing 10 or drawing 11 . Thus, if the point light source 7 is made to counter and the concave optical incidence section 13 is formed in a light guide plate 2, as shown in drawing 12 Since the light f3 which can also incorporate the light by which total reflection is carried out on the side 8 of a light guide plate 2 from the optical incidence section 13 to a light guide plate 2, and moreover carries out incidence from the side of the optical incidence section 13 is refracted so that it may go to the corner of a light guide plate 2 if there is no optical incidence section 13 It can prevent sending light to the corner of a light guide plate 2, and becoming dark. Consequently, luminance distribution can be made uniform also near the point light source 7 like the luminance distribution shown in drawing 13 .

[0012] Here, when a required light is considered within a light guide plate, the required quantity of light changes with directions centering on the point light source. For example, in the direction of a vertical angle, as shown in drawing 14 , since the distance to the edge of a light guide plate becomes the largest, it is

necessary to distribute most many quantity of lights in this direction. On the other hand, the quantity of light distributed is good for a direction parallel to the side 8 in which the optical incidence section 13 is formed, at least. In detail, the brightness of the optical outgoing radiation side 10 is brightness =kx(diffusion density of diffusion pattern) x (quantity of light).
However, since k is expressed with a proportionality constant, the distribution of the pattern density and the quantity of light of a diffusion pattern is determined that brightness will become uniform in respect of [10 / whole] optical outgoing radiation. Therefore, the ideal quantity of light distribution when making into 0 degree a direction perpendicular to the side 8 in which the optical incidence section 13 is formed is shown by drawing 15 . However, since there is a loss of light in fact, many quantity of lights are sent in each direction for a while rather than this.

[0013] However, when the position of the point light source 7 over the optical incidence section shifts from the design position shown with a dashed line to drawing 16 in the position shown as a solid line according to the error at the time of the assembly of surface light source equipment or a light-emitting part etc., the beam of light f4 shown in drawing 16 and drawing 17 with a dashed line for this position gap will disappear, and the beam of light f5 shown in drawing 16 and drawing 17 as a solid line will newly occur. And the quantity of light increases, brightness becomes high, in the direction of the newly generated beam of light f5, the luminance distribution which met crosswise [of a light guide plate 2] (D1-D2 line) comes to be shown in drawing 18 , since the quantity of light carries out a contingency and brightness falls, in the direction of the beam of light f4 which disappeared, the ununiformity of luminance distribution occurs and the nonuniformity of luminance distribution produces it in a light guide plate 2 by position gap of the point light source 7.

[0014] In addition, although explained taking the case of the case where the number of the point light sources is one here, even when two or more point light sources are used like the surface light source equipment of drawing 1 , there is same problem. However, since the point light source goes straight on with one surface light source equipment and light goes straight on by plane view within a light guide plate, the influence of a position gap of the point light source is larger than the case where the point light source is plurality.

[0015] The place which it is made in order that this invention may solve an above-mentioned technical issue point, and is made into the purpose is in the surface light source equipment which had the optical incidence section formed in the optical plane of incidence of a light guide plate to make small influence of the point light source of a position gap to the optical incidence section.

[0016]
[Description of the Invention] The light guide plate according to claim 1 is characterized by preparing two or more stomata or slots which stand in a row outside near [the optical incidence section] the above, and carrying out diffuse reflection of the introduced light in the direction of the interior on a boundary with the aforementioned stoma or a slot in the light guide plate which extends the light introduced from the optical incidence section inside, and carries out outgoing radiation to the shape of a field from an optical outgoing radiation side.

[0017] If it is in the light guide plate indicated to the claim 1, since the stoma or slot which carries out diffuse reflection of the light introduced from the optical incidence section is prepared near the optical incidence section of a light guide plate, diffuse reflection of the light introduced in the light guide plate from the optical incidence section is carried out by a stoma or the slot. Consequently, even if the direction of a beam of light which carries out incidence to the optical incidence section changes, change of the luminance distribution by change of the direction of a beam of light is equalized, and generating of brightness nonuniformity is suppressed. Therefore, luminance distribution can be kept uniform even if the direction of the beam of light introduced into a light guide plate differs from a design value.

[0018] An embodiment according to claim 2 makes the field where monotonous abbreviation rectangular parallelepiped-like transparent area is large an optical outgoing radiation side in a light guide plate according to claim 1. As the optical incidence section is prepared in the field where area is small, the aforementioned stoma which does not reach the aforementioned optical outgoing radiation side from the aforementioned optical outgoing radiation side and the field of an opposite side is opened and this stoma is closed, it is mostly characterized by the thing of the aforementioned optical outgoing radiation side and the field of an opposite side made for the whole to fix a reflecting plate.

[0019] The embodiment of a claim 2 is the case where a stoma is prepared in a light guide plate, and since it could pass through this crevice and light could reach behind the stoma, since the crevice was between the nose of cam of a stoma, and the optical outgoing radiation side, and the reflecting plate has countered the opening edge of a stoma, the light which came out from the opening edge of a stoma can reflect by the reflecting plate, and can reach behind a stoma. Therefore, even if it prepares a stoma in a light guide plate, it can prevent that a shadow arises behind a stoma.

[0020] In the surface light source equipment which has the light guide plate which surface light source equipment according to claim 3 extends the light introduced from the optical incidence section which counters the light source and this light source inside, and carries out outgoing radiation to the shape of a field from an optical outgoing radiation side Two or more stomata or slots which stand in a row outside are prepared near the aforementioned optical incidence section of the aforementioned light guide plate, and it is characterized by carrying out diffuse reflection of the light introduced into the aforementioned light guide plate in the direction of the interior of the aforementioned light guide plate on a boundary with the aforementioned stoma or a slot.

[0021] If it is in the surface light source equipment indicated to the claim 3, since the stoma or slot which carries out diffuse reflection of the light introduced from the optical incidence section is prepared near the optical incidence section of a light guide plate, diffuse reflection of the light introduced in the light guide plate from the optical incidence section is carried out by a stoma or the slot. Consequently, even if the position of the light source to the optical incidence section shifts, change of the luminance distribution by position gap of the light source is equalized, and generating of brightness nonuniformity is suppressed. Therefore, luminance distribution can be kept uniform even if the position of the light source shifts from a design position.

[0022] Surface light source equipment according to claim 4 is characterized by forming irregularity in the front face of the aforementioned light source, and introducing the diffused light in the aforementioned light guide plate from the aforementioned optical incidence section in the surface light source equipment which has the light source and the light guide plate which extends the light introduced from the optical incidence section which counters this light source inside, and carries out outgoing radiation to the shape of a field from an optical outgoing radiation side.

[0023] If it is in the surface light source equipment indicated to the claim 4, since irregularity is prepared on the surface of the light source, the light introduced into a light guide plate is diffused in case outgoing radiation is carried out from the light source. Consequently, even if the position of the light source to the optical incidence section shifts, change of the luminance distribution by position gap of the light source is equalized, and generating of brightness nonuniformity is suppressed. Therefore, luminance distribution can be kept uniform even if the position of the light source shifts from a design position.

[0024] In the surface light source equipment which has the light guide plate which surface light source equipment according to claim 5 extends the light introduced from the optical incidence section which counters the light source and this light source inside, and carries out outgoing radiation to the shape of a field from an optical outgoing radiation side Two or more eyes a line were prolonged in the almost perpendicular direction are prepared in the aforementioned optical incidence section of the aforementioned light guide plate with an optical outgoing radiation side, and it is characterized by diffusing the light introduced from the aforementioned optical incidence section of the aforementioned light guide plate by eye the aforementioned line. Here, it is narrow line-like irregularity in eye a line, and eye a line is also contained in the slot as used in this specification.

[0025] If it is in the surface light source equipment indicated to the claim 5, since eye a line diffuse the light introduced from the optical incidence section is prepared in the optical incidence section, the light introduced in a light guide plate from the optical incidence section is diffused by eye a line. Consequently, even if the position of the light source to the optical incidence section shifts, change of the luminance distribution by position gap of the light source is equalized, and generating of brightness nonuniformity is suppressed. Therefore, luminance distribution can be kept uniform even if the position of the light source shifts from a design position.

[0026]
[Embodiments of the Invention] (1st operation gestalt) Drawing 19 is the decomposition perspective diagram showing the structure of the surface light source equipment 21 by 1 operation gestalt of this invention.
The light guide plate 22 is formed of transparent resin material with a big refractive index, and the upper surface of a light guide plate 22 is the optical outgoing radiation side 23. The diffusion pattern 33 is formed in the inferior surface of tongue of a light guide plate 22 of concavo-convex processing, dot printing of diffuse reflection ink, etc. This diffusion pattern 33 is arranged in the shape of a concentric circle focusing on the point light source 25 which is made to counter the optical incidence section 24 of a light guide plate 22, and is arranged, and the pattern density of the diffusion pattern 33 is becoming large gradually as the distance from the point light source 25 becomes large (refer to drawing 24 and drawing 4). Moreover, the reflecting plate 26 formed of material with a high surface reflection factor like a white sheet plastic is stuck on the inferior surface of tongue of a light guide plate 22 by the double-sided tape etc.

[0027] The optical big incidence section 24 is cut in the point light source 25 and the position which counters for a while rather than the point light source 25 among the sides of a light guide plate 22. As shown in drawing 20 , the fine vertical reinforcement (eye a line) 30 prolonged in the direction perpendicular to the optical outgoing radiation side 23 is uniformly formed in the inside and the field of both sides of this optical incidence section 24. molding for this vertical reinforcement 30 casting a light guide plate 22 -- metal mold -- a vertical reinforcement 30 -- preparing -- the time of molding of a light guide plate 22 -- molding -- the vertical reinforcement 30 of metal mold should just be imprinted by the light guide plate 22

Or transparent ultraviolet-rays hardening resin (UV resin) is applied to the field of the optical incidence section 24 of the cast light guide plate 22, and its both sides, and while imprinting a fluting to ultraviolet-rays hardening resin by La Stampa, ultraviolet rays are irradiated and you may make it make it harden (the PhotoPolymerization method).

[0028] mounting which a light-emitting part 27 becomes from the quality of the material with high surface reflection factors, such as a white resin, -- the point light source 25 (it compares with a light guide plate 22, and is the small light source) of light emitting diode, a miniature bulb, etc. is attached in a member 28 moreover -- the upper part of the point light source 25, and a lower part -- mounting -- the covering section 29 has extended from the upper limb and margo inferior of a member 28 The covering section 29 has prevented that have come to fit into the optical incidence section 24 cut in the light guide plate 22, and light leaks from the crevice between the point light source 25 and a light guide plate 22 to the upper part and a lower part.

[0029] Thus, if the vertical reinforcement 30 is formed in the field of the point light source 25, the optical incidence section 24 which counters, and its both sides, the light f which carries out incidence into a light guide plate 22 will be made to go in the direction which goes to the corner of a light guide plate 22 from the optical incidence section 24 or its circumference by the optical incidence section 24, and as shown in drawing 20 , it will be further spread in a field parallel to the optical outgoing radiation side 23 by the vertical reinforcement 30. Moreover, the vertical reinforcement 30 prepared in optical incidence section 24 both sides is led to the light guide plate 22 interior, without carrying out total reflection of the light of the point light source 25. Therefore, according to the surface light source equipment 21 using such a light guide plate 22, while making use efficiency of light high, the luminance distribution in the optical outgoing radiation side 23 can be equalized, and it can prevent that especially the corner of a light guide plate 22 becomes dark.

[0030] Drawing 21 shows the situation when the point light source 25 shifts from a design position. A dashed line shows the design position of the point light source 25, and a solid line shows the position of the point light source 25 which carried out the position gap according to the error etc. Moreover, a solid line shows the light f6 generated when the point light source 25 carried out the position gap, and the light f7 which disappears by position gap is expressed with the dashed line. With this surface light source equipment 21, since the vertical reinforcement 30 is formed in the optical incidence section 24 and its near, the light f6 generated by position gap of the point light source 25 and the disappearing light f7 are diffused by passing a vertical reinforcement 30, and as shown in drawing 21 or drawing 22 compared with the time of there being no vertical reinforcement 30, it progresses with a flare. The influence of a position gap of the point light source 25 is distributed and equalized, and the luminance distribution which met crosswise [of the optical outgoing radiation side 23] is equalized as the solid line curve 31 shows to drawing 23 (luminance distribution in case there is no dashed line curve 32 of 30 vertical reinforcement of drawing 23), and brightness nonuniformity stops for this reason, being conspicuous.

[0031] On the other hand, in a light guide plate cross section perpendicular to the side in which the optical incidence section 24 was able to be formed, since the light f which carries out incidence to a light guide plate 22 is not diffused by the vertical reinforcement 30 as shown in drawing 24 , it is suppressed that a lot of light leaks near the optical incidence section 24, and become the loss of light or a local bright point is generated.

[0032] With the above-mentioned operation gestalt, although the case of the one point light source 25 was explained, this operation gestalt can be applied, when the light-emitting part 27 equipped with two or more point light sources 25 is used, as shown in drawing 25 . Even if it forms a vertical reinforcement 30 in the field of the optical incidence section 24 which was made to counter each point light source 25, and was prepared in the light guide plate 22 like this surface light source equipment 34, and its both sides, respectively, while raising the use efficiency of light, even if it can make the ununiformity of luminance distribution small and the position of the point light source 25 shifts further, it is hard coming to generate brightness nonuniformity.

[0033] (2nd operation gestalt) Drawing 26 is a plan in which it is expanded and shown near the optical incidence section 24 of the light guide plate 22 by another operation gestalt of this invention and which was fractured in part. If it is in this operation gestalt, in the field of the optical incidence section 24 and its both sides, the flat-surface portion 35 is formed between vertical reinforcements 30 by forming a vertical reinforcement 30 intermittently. Moreover, with the operation gestalt shown in drawing 27 , the flat-surface portion 35 is formed in the field of the optical incidence section 24 of a light guide plate 22, and its both sides between the vertical reinforcements 30 which gathered while carrying out two or more continuous formation of the vertical reinforcement 30.

[0034] Since the light which passed the flat-surface portion 35 between vertical reinforcements 30 does not spread to the light which passed the vertical reinforcement 30 diffusing, according to these operation gestalten, the diffusing capacity of the light which carried out incidence can be adjusted in a light guide plate 22 by [of the flat-surface portion 35 between the field of a vertical reinforcement 30, and a vertical reinforcement 30] changing comparatively.

[0035] (3rd operation gestalt) The decomposition perspective diagram showing the structure of surface light source equipment 41 according [drawing 28] to still more nearly another operation gestalt of this invention and drawing 29 are the expansion perspective diagrams in which showing the structure near the optical incidence section 24 of the light guide plate 22 and which were fractured in part. If it is in this surface light source equipment 41, as the optical incidence section 24 is surrounded, two or more stomata 42 are formed in the optical incidence section 24 circumference of a light guide plate 22. Each stoma 42 is carrying out the shape of a pillar, is prepared at right angles to the optical outgoing radiation side 23, is prepared, and is penetrated to the optical outgoing radiation side 23 and the field 43 of the opposite side. However, as shown in drawing 30 , as for each stoma 42, it is desirable to prepare in the un-effective field outside the field of the diffusion pattern 33 of a light guide plate 22 (for example, the non-display side in the case of using as a back light of a liquid crystal display panel and the field which counters).

[0036] Thus, if a stoma 42 is formed in the circumference of the optical incidence section 24, the light f which carried out incidence into the light guide plate 22 from the optical incidence section 24 will diffuse the light f which hit the stoma 42 as refraction or by carrying out total reflection showed to drawing 29 according to the interface of a stoma 42 and the space of the interior in a stoma 42. Consequently, the same operation effect as the vertical reinforcement 30 in the 1st operation form can be dedicated by this stoma 42. That is, when the light f which carried out incidence into the light guide plate 22 from the optical incidence section 24 diffuses in a stoma 42, light also comes to arrive at the corner of a light guide plate 22, and it can prevent that the corner of a light guide plate 22 becomes dark. And since the stoma 42 has turned to the direction perpendicular to the optical outgoing radiation side 23, the light f which hit the stoma 42 is not diffused in the vertical direction, and a local bright section does not produce it near the stoma 42. Furthermore, it can prevent that brightness nonuniformity arises influenced by the point light source 25 of a position gap to the optical incidence section 24 by diffusing the light f which carried out incidence from the optical incidence section 24 by the stoma 42.

[0037] Moreover, the cross-section configuration of a stoma 42 can enlarge the diffusion effect of the light by the stoma 42, if it is made to become for it to be long in the direction to which the light from the point light source 25 comes, and short in the direction which intersects perpendicularly with it. For example, the cross-section configuration of a stoma 42 is made into the shape of an ellipse, and you may make it the direction of a major axis of the ellipse become the direction and parallel by which the light f from the point light source 25 comes, as shown in drawing 31 . If it does in this way, penetration of the light into a stoma 42 can be suppressed, the angle of the side of the stoma 42 to the light which came from the point light source 25 will become large, and the probability that light will be reflected by the stoma 42 will become high. Therefore, the diffusion effect by the stoma 42 can be made high.

[0038] Furthermore, as shown in drawing 32 , the cross-section configuration of a stoma 42 can be made into a wedge shape, if a wedge-shaped nose of cam is turned in the direction of the light f which comes from the point light source 25, penetration of the light into a stoma 42 can be suppressed, the reflection factor by the stoma 42 can be enlarged, and the diffusion effect by the stoma 42 can be made still higher.

[0039] In addition, this operation form explained the case of the one point light source 25, and this operation form is applicable also to the surface light source equipment 44 using the light-emitting part 27 equipped with two or more point light sources 25, as shown in drawing 33 .

[0040] (4th operation form) Drawing 34 and drawing 35 are the expanded sectional views showing the structure of the stoma 42 by still more nearly another operation form of this invention which the light guide plate 22 fractured the part. With this operation form, although each is carrying out opening of two or more stomata 42 prepared in the circumference of the optical incidence section 24 of a light guide plate 22 in respect of [43] the optical outgoing radiation 23 and the opposite side, they are not given to the optical outgoing radiation side 23.

[0041] Although there is a possibility of a shadow arising behind a stoma 42 (the point light source 25 and opposite side), and becoming dark space, in the stoma 42 penetrated to the upper and lower sides which were stated with the 3rd operation form If a stoma 42 does not reach the optical outgoing radiation side 23 like this operation form but a crevice is between the upper limit of a stoma 42, and the optical outgoing radiation side 23, as shown in drawing 34 , the light f which carried out incidence to the light guide plate 22 will reach behind a stoma 42 through this crevice. Furthermore, since opening of the stoma 42 is carried out in respect of [43] the optical outgoing radiation 23 and the opposite side, as shown in drawing 35 , it is reflected by the reflecting plate 26 which has fixed on the undersurface of a light guide plate 22, and the light f which came out of undersurface opening of a stoma 42 returns to the light guide plate 22 interior in the back of a stoma 42. Therefore, according to this operation form, it can prevent a shadow being made behind a stoma 42 and becoming dark behind.

[0042] Moreover, with this operation form, the amount of diffusion of light can also be adjusted by adjusting the height of a stoma 42, and the interval of stoma 42.

[0043] However, even if it carries out opening of the stoma 42 to the cross-section configuration of a stoma 42 being almost the same from a top to the bottom in respect of the optical outgoing radiation 23 and an opposite side, being refracted by the interface of a stoma 42, as shown in drawing 36 , or when being reflected by the reflecting plate 26 by undersurface opening of a stoma 42, Light f leaks from the upper surface of a stoma 42 somewhat, and it escapes to the optical outgoing radiation side 23. If it is made to become so small that the cross section of a stoma 42 approach the optical outgoing radiation side 23, for example, a stoma 42 is made into the shape of a cone and the upper surface of a stoma 42 is lost as shown in drawing 37 in order to prevent this, it can prevent being able to shut up altogether the light f which passed along the stoma 42 in a light guide plate 22, and Light f leaking to the optical outgoing radiation side 23 in the upper part of a stoma 42, and becoming brightness nonuniformity.

[0044] (5th operation form) Drawing 38 is the decomposition perspective diagram of the surface light source equipment 51 by still more nearly another operation form of this invention. If it is in this surface light source equipment 51, two or more slots 52 are cut in the upper surface, the undersurface, or vertical both sides of a light guide plate 22 in the circumference of the optical incidence section 24. As shown in drawing 39 , the slot 52 is formed in the abbreviation radial so that each length direction may become parallel to the direction of the light f which comes by plane view from the light source. Furthermore, each slot 52 is formed in the boiled-fish-paste form as shown in drawing 40 . Diffuse reflection is carried out in the various directions by the light f by which carried out the deer and outgoing radiation was carried out from the point light source 25 advancing into a light guide plate 22 from the optical incidence section 24, and being reflected in a slot 52 in a slot 52. Consequently, Light f can be uniformly distributed within a light guide plate 22, and brightness nonuniformity of surface light source equipment 51 can be made small. Even if the point light source 25 is carrying out the position gap to the optical incidence section 24 especially according to the error, it is hard coming to generate brightness nonuniformity. Moreover, a slot 52 is the direction and parallel to which light progresses, and each light f is accepted and diffused in the direction which intersects perpendicularly with the travelling direction, it is ** and can also perform the design of a diffusion pattern easily. Furthermore, if the size of a slot 52, the depth, length, density, etc. are adjusted, the diffusion degree of the light by the slot 52 can also be adjusted. In addition, as this slot 52, you may be detailed linear irregularity as shown as a vertical reinforcement.

[0045] Moreover, this operation form is applicable also to the surface light source equipment 53 which was able to form two or more point light sources 25 and two or more optical incidence sections 24, as shown in drawing 41 .

[0046] (6th operation form) Drawing 42 is the decomposition perspective diagram judging and showing some surface light source equipments 61 by still more nearly another operation form of this invention. Irregularity is formed in the front face of the point light source 25 if it is in this surface light source equipment 51. That is, as shown in drawing 43 , the point light source 25 is fabricated with the transparent mould resin 64 in a luminescence chip 63 like a Light Emitting Diode chip, and the diffusion pattern 62 is formed in the front face of this mould resin 64. What is necessary is not to be a line and just to be only able to diffuse light in it as this diffusion pattern 62, although the concave protruding line 62 prolonged in the direction perpendicular to the covering section 29 is expressed with the example of illustration. Since the covering section 29 is formed in the upper and lower sides of the point light source 25, light may leak to the upper part or a lower part, a bird clapper may not be in a loss, and, therefore, a crepe-like thing is sufficient as the diffusion pattern 62.

[0047] Drawing 43 shows the situation when the luminescence chip 63 shifts from a design position. A dashed line shows the design position of the luminescence chip 63, and a solid line shows the position of the point light source 20 which carried out the position gap according to the error etc. Moreover, a solid line shows the light f6 generated when the point light source 25 carried out the position gap, and the light f7 which disappears by position gap is expressed with the dashed line. With this surface light source equipment 61, since the diffusion pattern 62 is formed in the point light source 25, the light f6 generated by position gap of the luminescence chip 63 and the disappearing light f7 are diffused by passing the diffusion pattern 62, and carry out incidence to the optical incidence section 24. The influence of a position gap of the luminescence chip 63 is distributed and equalized, and brightness nonuniformity stops for this reason, being conspicuous.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the decomposition perspective diagram showing conventional surface light source equipment.
[Drawing 2] It is the cross section showing the behavior of the light in a light guide plate same as the above.
[Drawing 3] It is the plan showing the behavior of the light in a light guide plate same as the above.
[Drawing 4] It is the plan showing another conventional surface light source equipment.
[Drawing 5] It is drawing showing the behavior of the light in the optical incidence section.
[Drawing 6] It is drawing showing the dark space of surface light source equipment same as the above.
[Drawing 7] It is drawing showing the luminance distribution which met A1-A2 line of a light guide plate same as the above.
[Drawing 8] It is drawing showing the dark space of still more nearly another conventional surface light source equipment equipped with two or more point light sources.
[Drawing 9] It is drawing showing ********** which met the B1-B-2 line of surface light source equipment same as the above.
[Drawing 10] It is drawing showing still more nearly another conventional surface light source equipment.
[Drawing 11] It is drawing showing still more nearly another conventional surface light source equipment.
[Drawing 12] It is the expansion plan of the optical incidence section of drawing 10 or the surface light source equipment of drawing 11 .
[Drawing 13] It is drawing showing the luminance distribution which met C1-C2 line of the surface light source equipment of drawing 10 .
[Drawing 14] It is drawing explaining the method of distribution of the light in the light guide plate which prepared the concave optical incidence section.
[Drawing 15] It is drawing showing the relation between the direction of light, and the quantity of light.
[Drawing 16] It is drawing showing change of the behavior of a beam of light when the position of the point light source shifts.
[Drawing 17] It is drawing showing change of the behavior of a beam of light when the position of the point light source shifts.
[Drawing 18] It is drawing showing the luminance distribution which met D1-D2 line of drawing 17 .
[Drawing 19] It is the decomposition perspective diagram showing the surface light source equipment by 1 operation gestalt of this invention.
[Drawing 20] It is the expansion perspective diagram showing the vertical reinforcement prepared in the optical incidence section.
[Drawing 21] In surface light source equipment same as the above, it is drawing showing change of the

behavior of light when the position of the point light source shifts.
[Drawing 22] In surface light source equipment same as the above, it is drawing showing change of the behavior of light when the position of the point light source shifts.
[Drawing 23] It is drawing showing the luminance distribution which met crosswise [of surface light source equipment same as the above].
[Drawing 24] It is the cross section showing the behavior of the light in a light guide plate.
[Drawing 25] It is the decomposition perspective diagram showing the surface light source equipment by another operation gestalt of this invention.
[Drawing 26] In still more nearly another operation gestalt of this invention, it is the plan showing the vertical reinforcement prepared in the optical incidence section, and a flat-surface portion fractured in part.
[Drawing 27] In still more nearly another operation gestalt of this invention, it is the plan showing the vertical reinforcement prepared in the optical incidence section, and a flat-surface portion fractured in part.
[Drawing 28] It is the decomposition perspective diagram showing the surface light source equipment by still more nearly another operation gestalt of this invention.
[Drawing 29] It is the expansion perspective diagram showing the stoma prepared near the optical incidence section.
[Drawing 30] It is the plan of the light guide plate in an operation gestalt same as the above.
[Drawing 31] In still more nearly another operation gestalt of this invention, it is the plan showing the stoma of another configuration established near the optical incidence section fractured in part.
[Drawing 32] In still more nearly another operation gestalt of this invention, it is the plan showing the stoma of another configuration established near the optical incidence section fractured in part.
[Drawing 33] It is the decomposition perspective diagram showing the surface light source equipment by still more nearly another operation gestalt of this invention.
[Drawing 34] It is the cross section showing the configuration of the stoma in still more nearly another operation gestalt of this invention.
[Drawing 35] It is operation explanatory drawing of an operation gestalt same as the above.
[Drawing 36] It is drawing explaining the trouble of a stoma same as the above.
[Drawing 37] It is the cross section showing the configuration of the stoma in still more nearly another operation gestalt of this invention.
[Drawing 38] It is the decomposition perspective diagram showing the surface light source equipment by still more nearly another operation gestalt of this invention.
[Drawing 39] It is the expansion plan showing the slot prepared near the optical incidence section.
[Drawing 40] It is the expansion perspective diagram showing the slot prepared near the optical incidence section.
[Drawing 41] It is the decomposition perspective diagram showing the surface light source equipment by still more nearly another operation gestalt of this invention.
[Drawing 42] It is the decomposition perspective diagram in which showing the surface light source equipment by still more nearly another operation gestalt of this invention and which was fractured in part.
[Drawing 43] In surface light source equipment same as the above, it is drawing showing change of the behavior of light when the position of the point light source shifts.
[Description of Notations]
22 Light Guide Plate
23 Optical Outgoing Radiation Side
24 Optical Incidence Section

25 Point Light Source
26 Reflecting Plate
27 Light-emitting Part
30 Vertical Reinforcement
35 Flat-Surface Portion
42 Stoma
52 Slot
62 Diffusion Pattern

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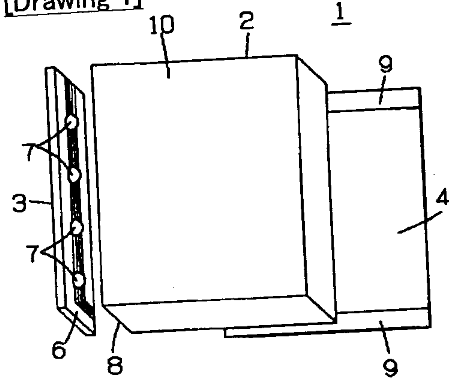
DRAWINGS

[Drawing 1]



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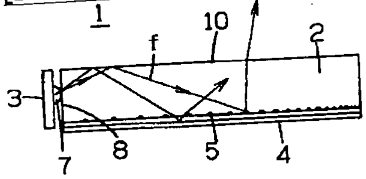

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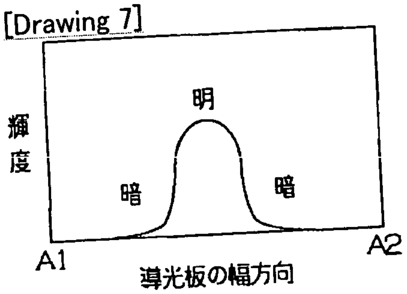

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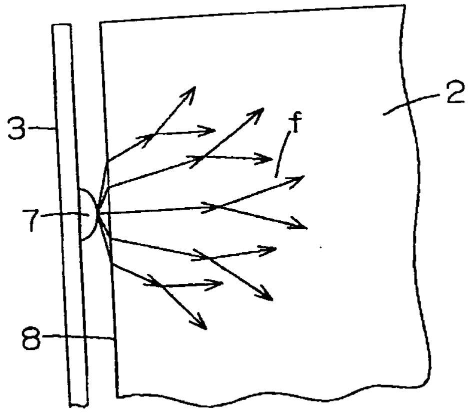

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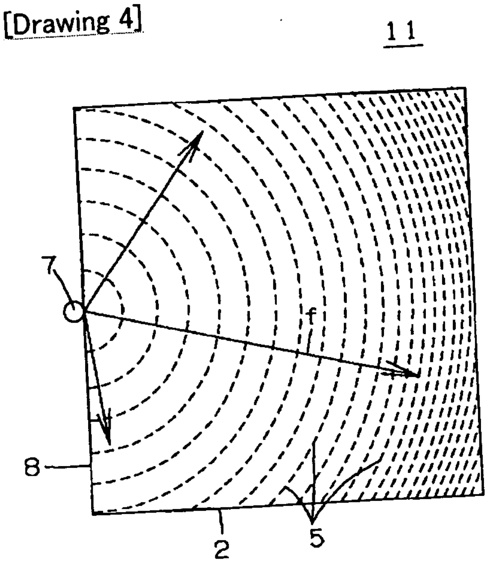

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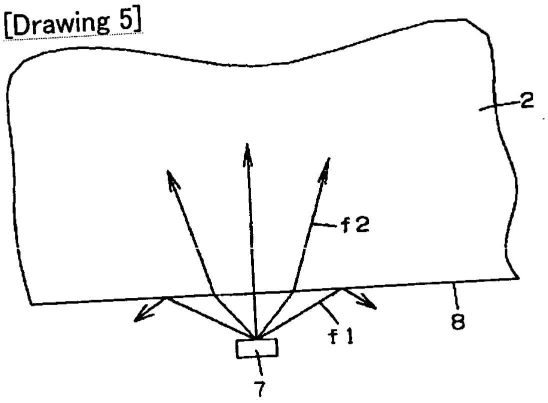

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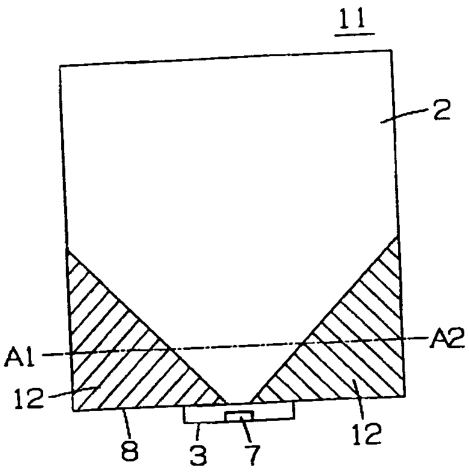

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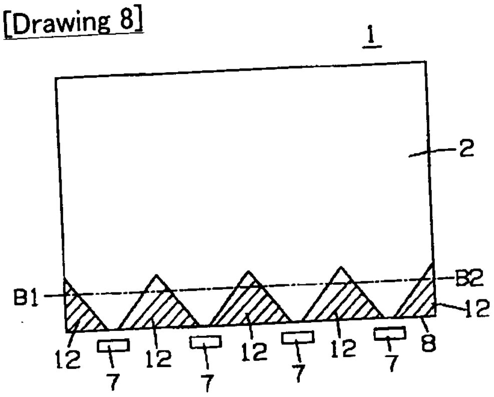

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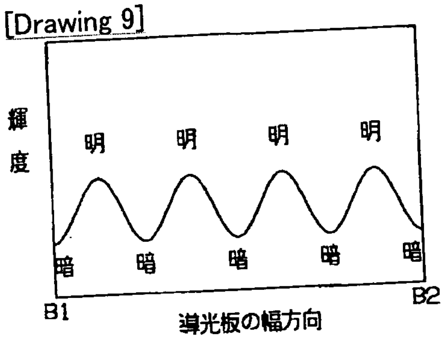

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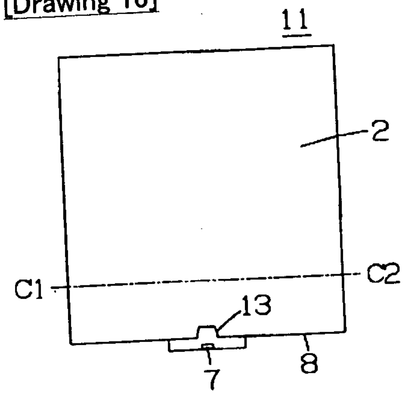

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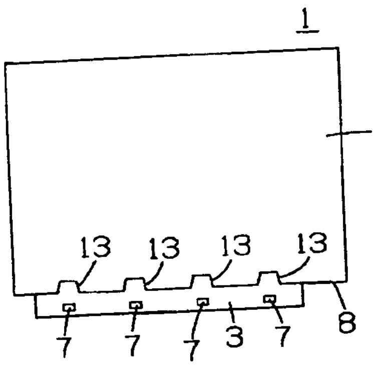

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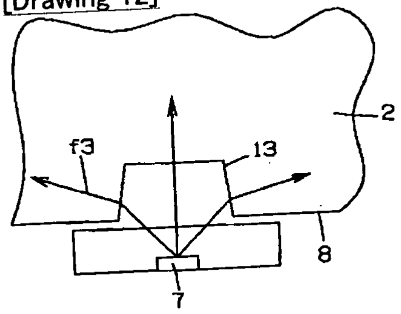

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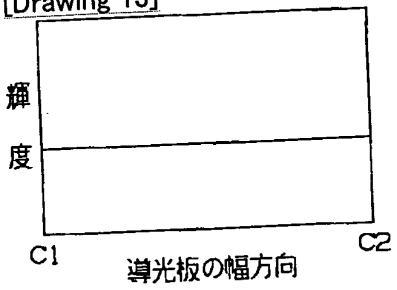

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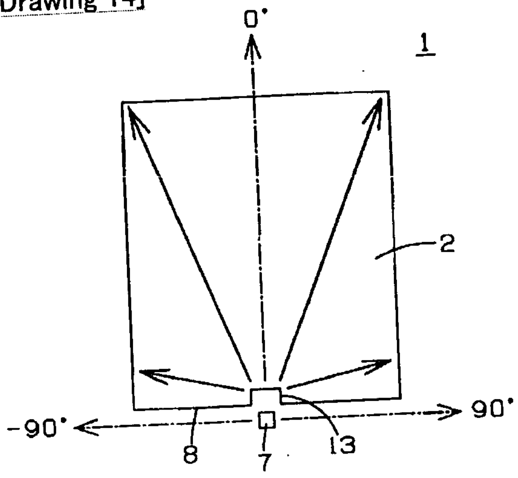

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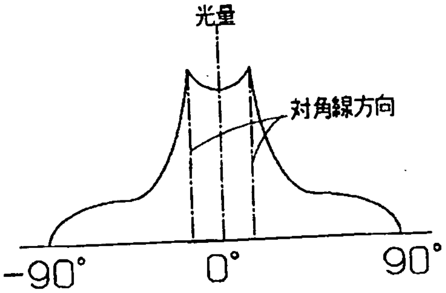

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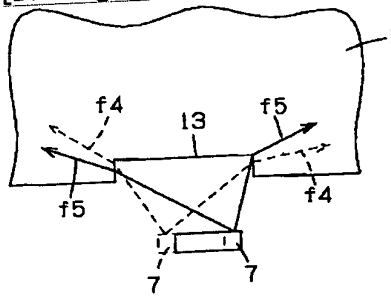

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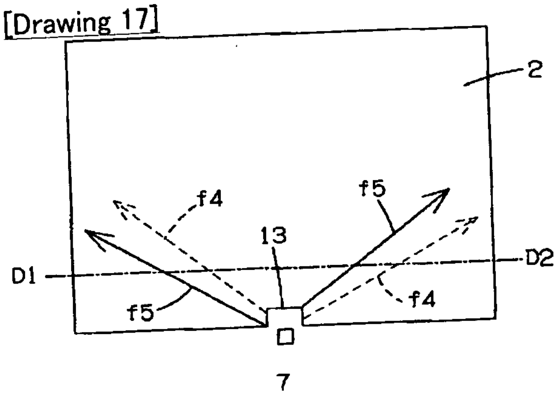

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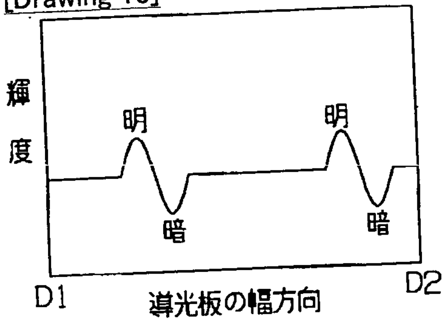

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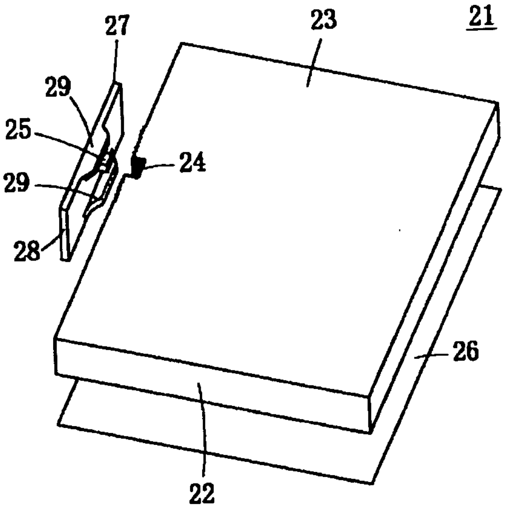

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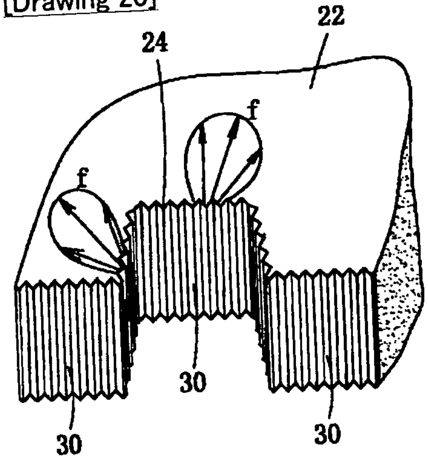

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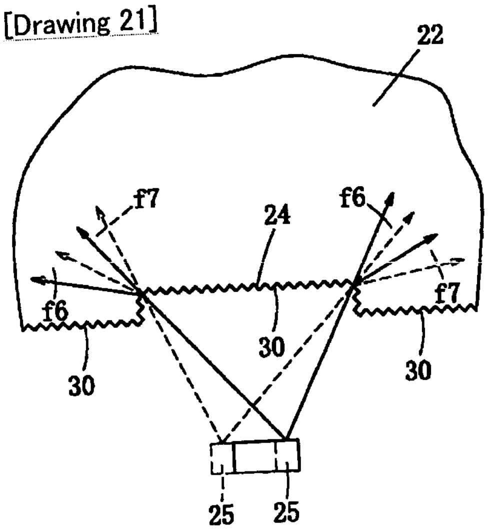

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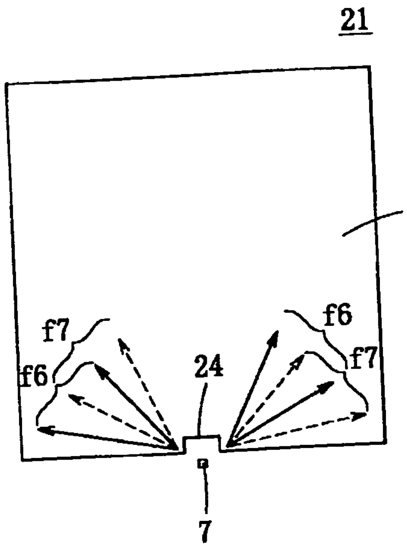

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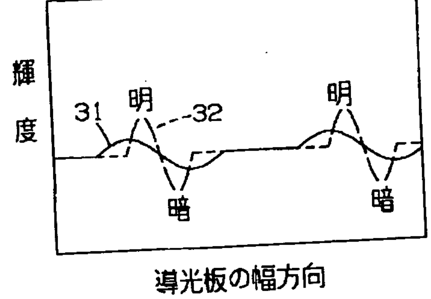

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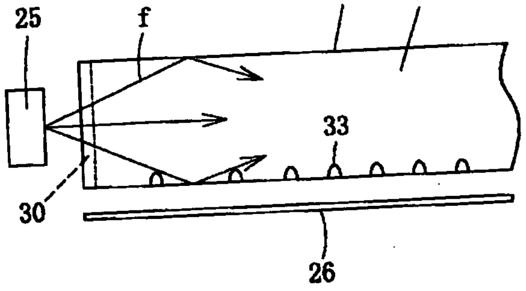

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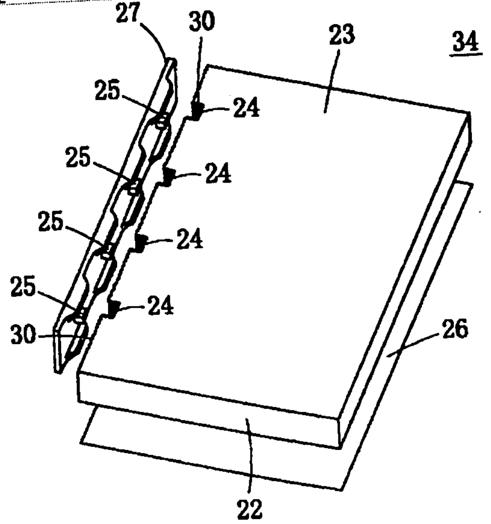

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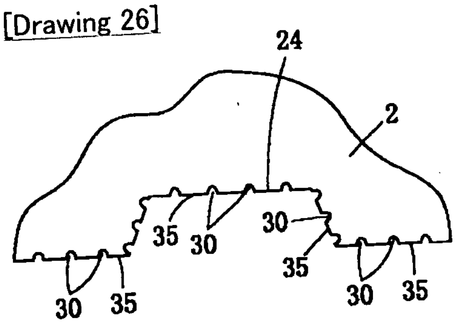

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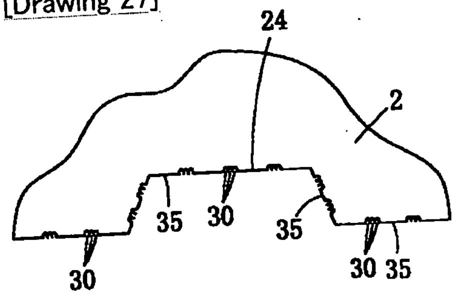

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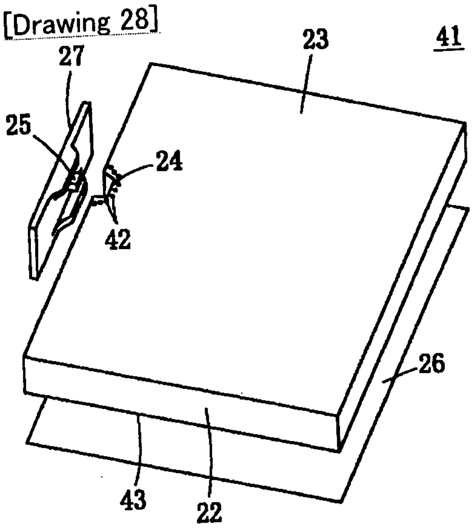

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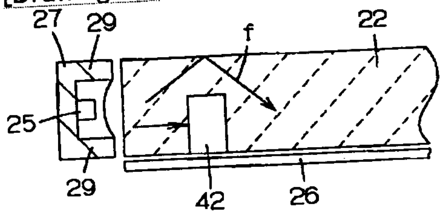

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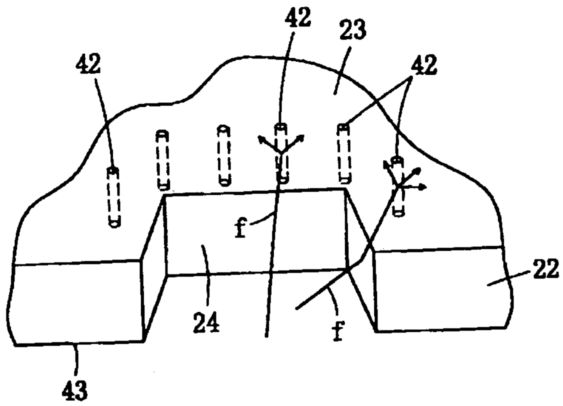

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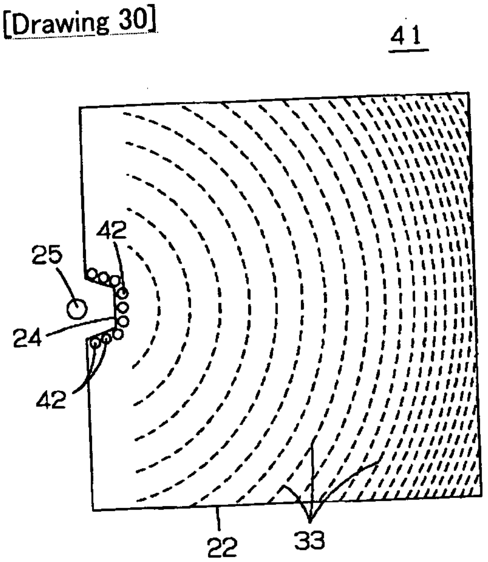

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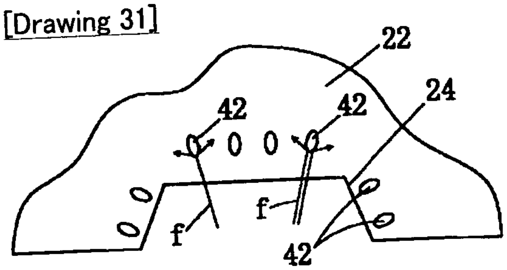

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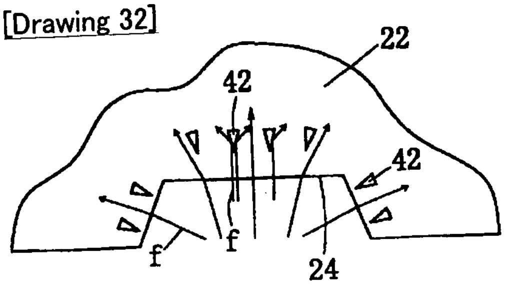

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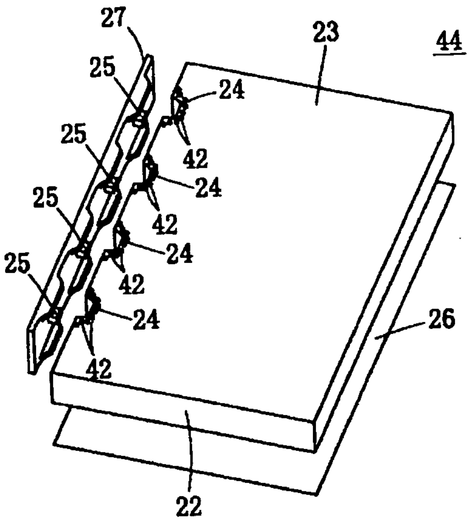

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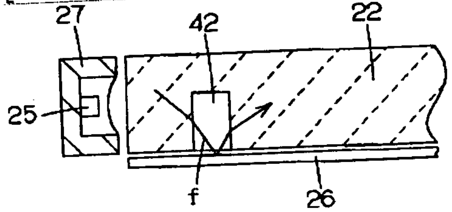

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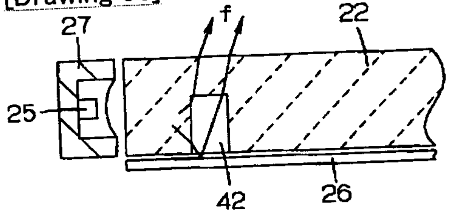

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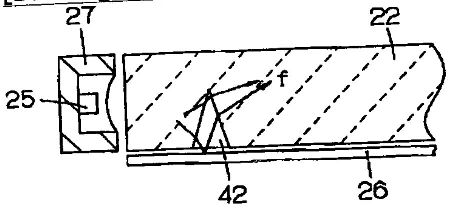

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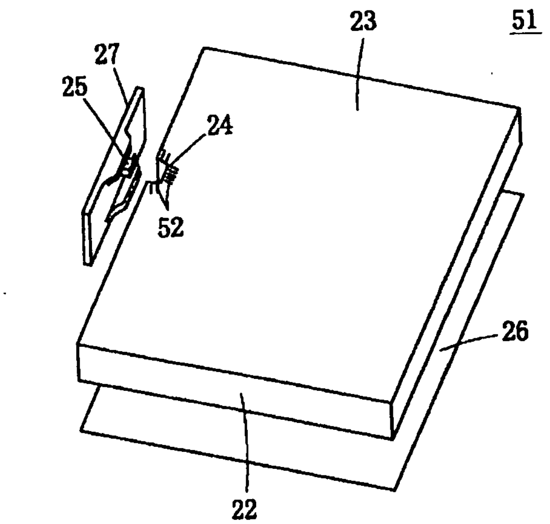

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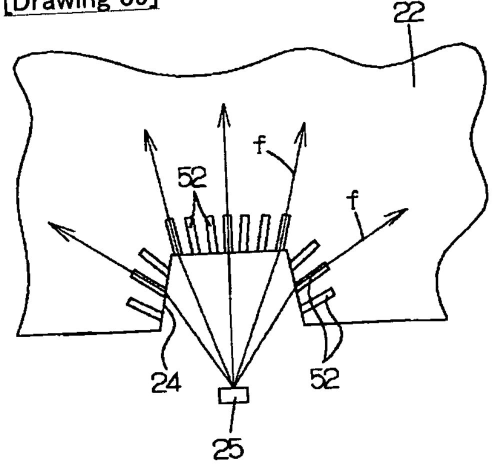

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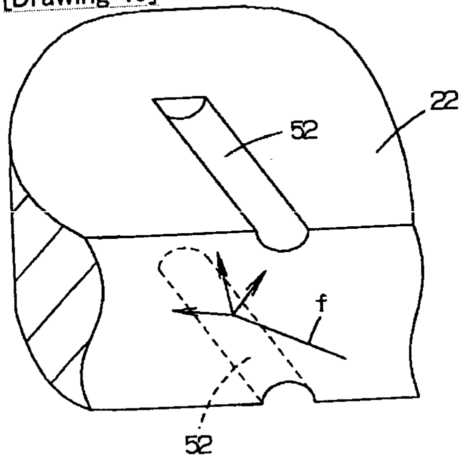

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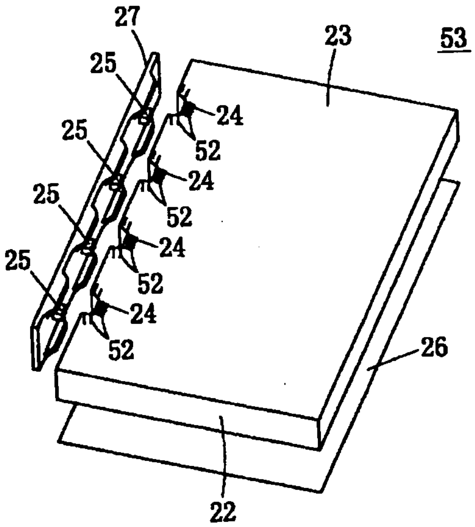

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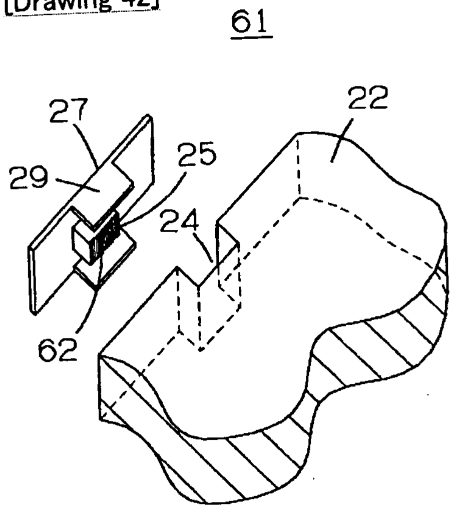

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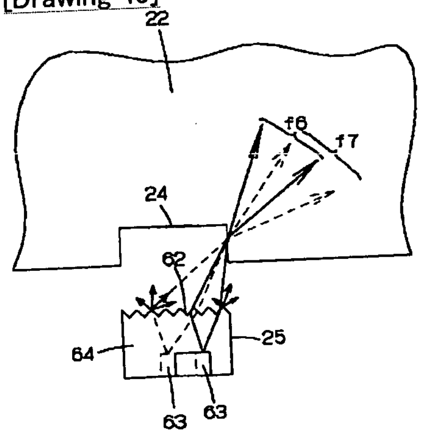

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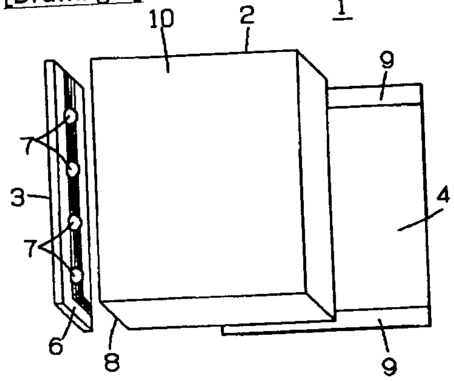
DRAWINGS

[Drawing 1]



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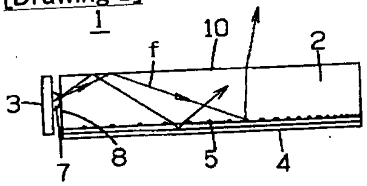

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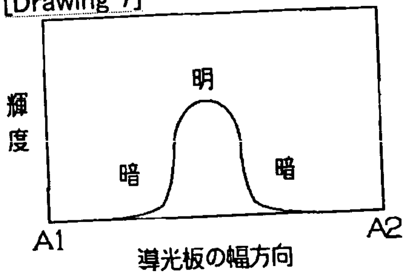

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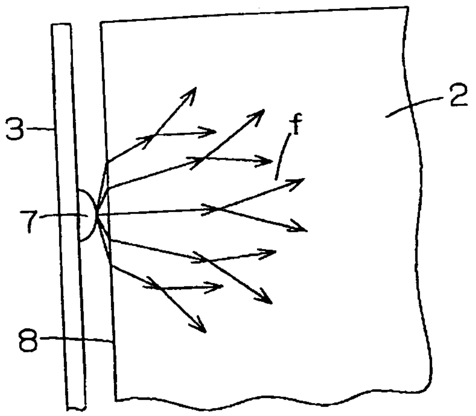

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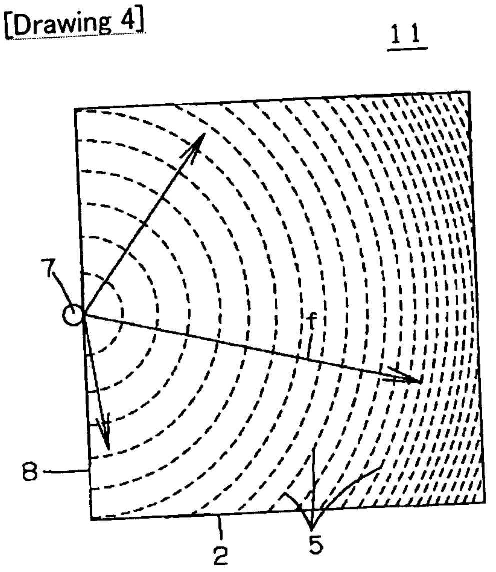

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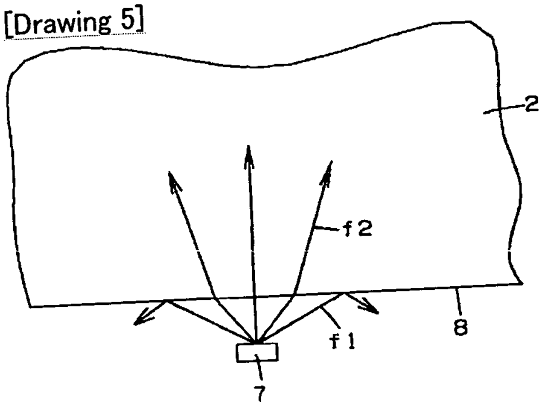

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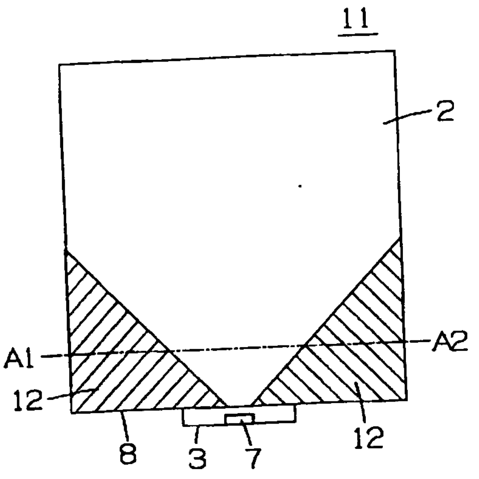

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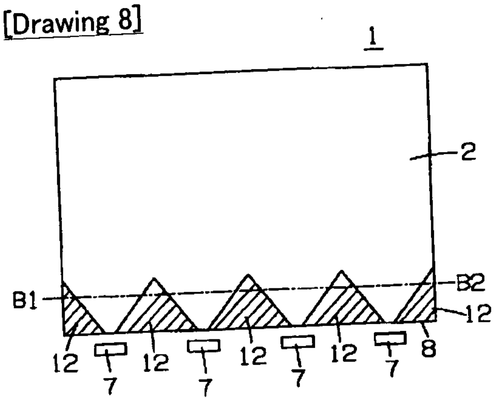

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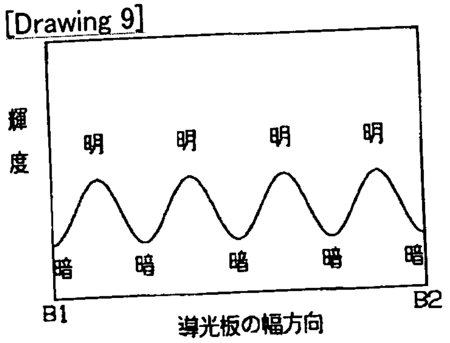

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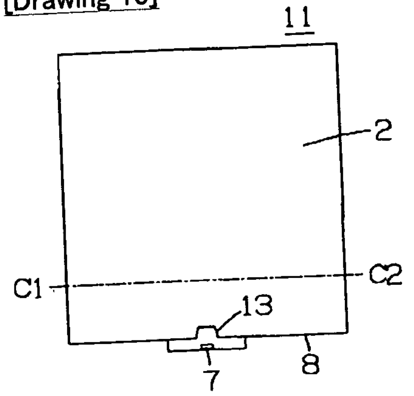

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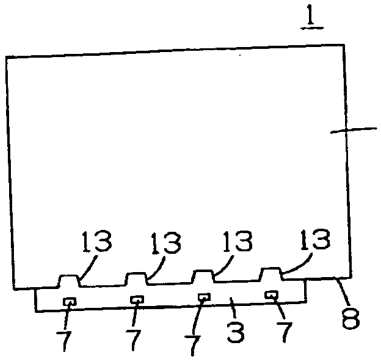

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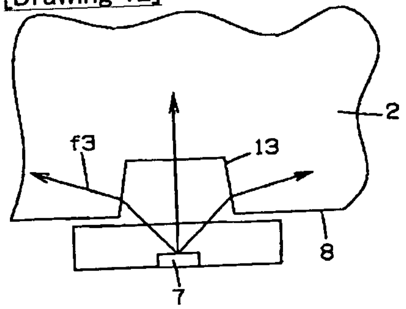

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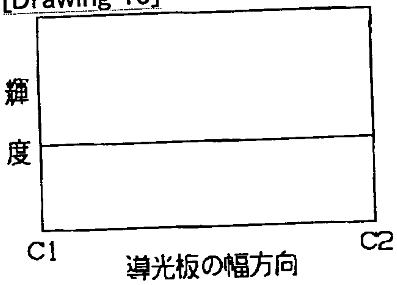

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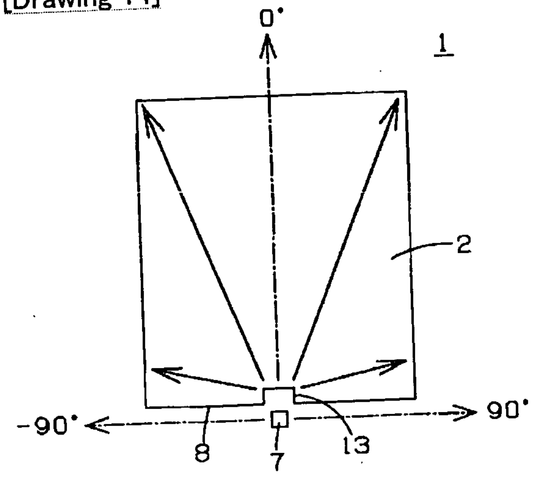

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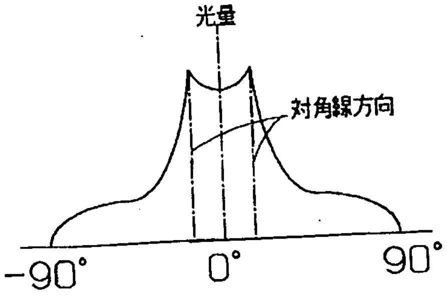

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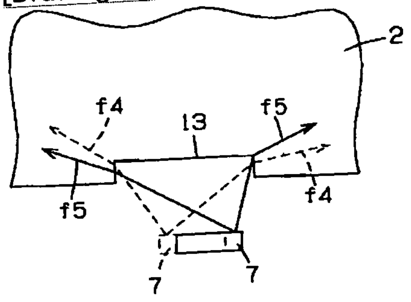

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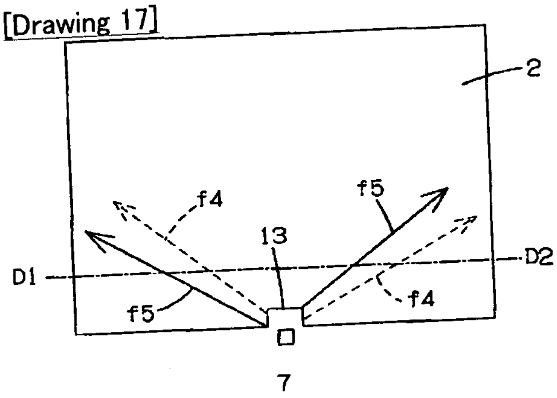

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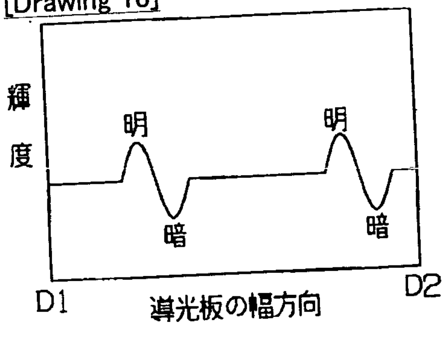

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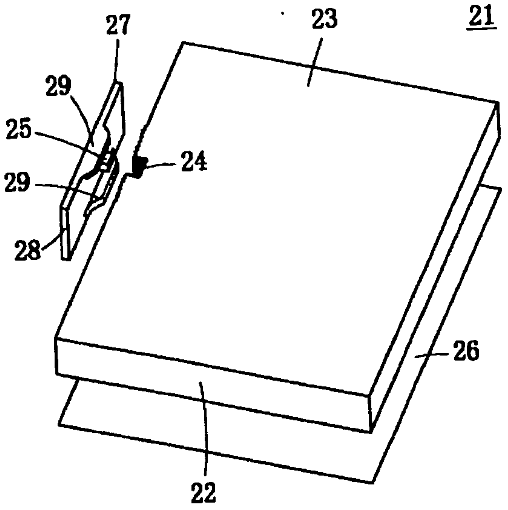

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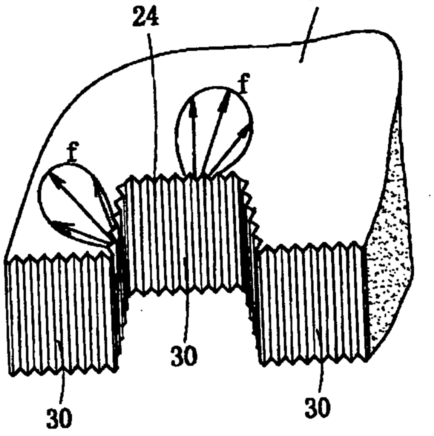

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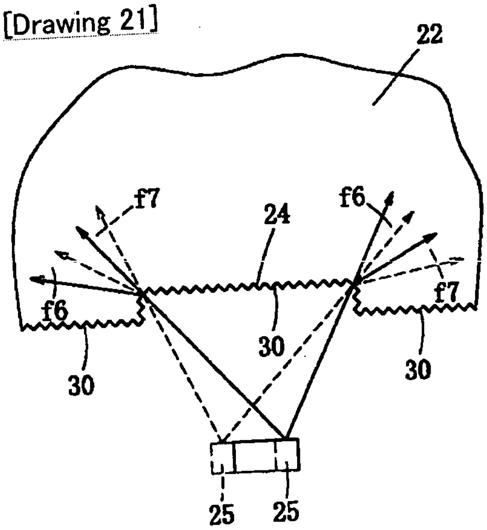

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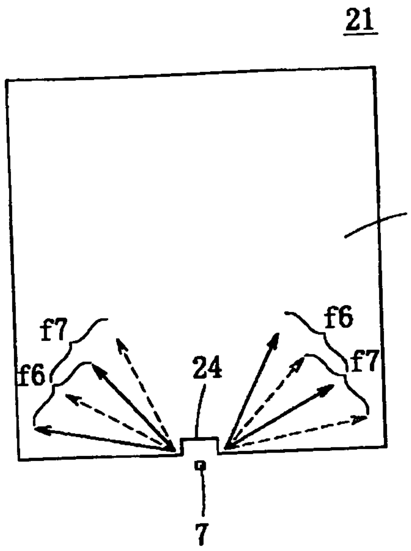

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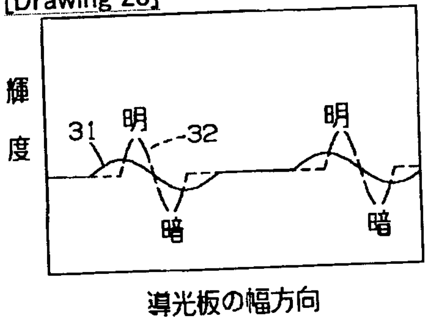

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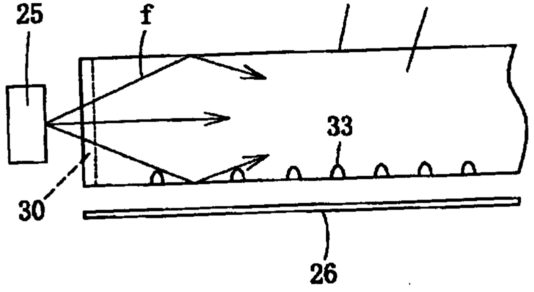

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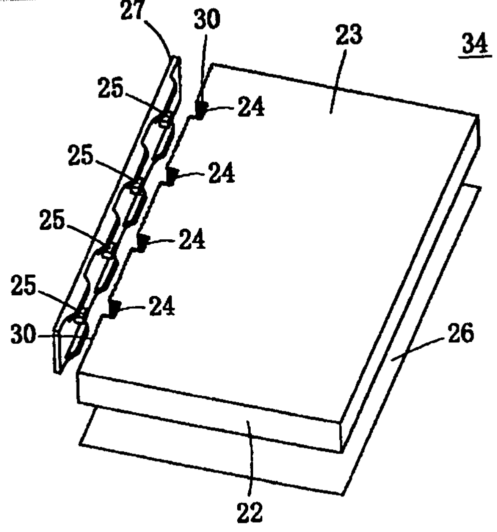

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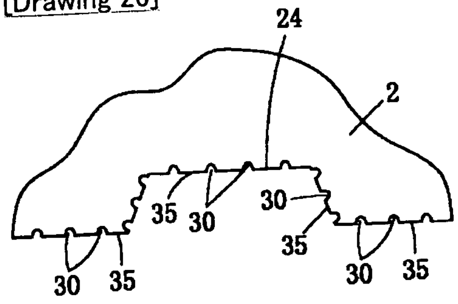

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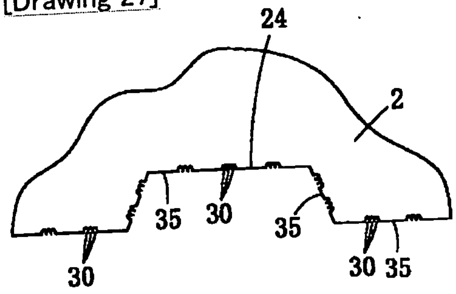
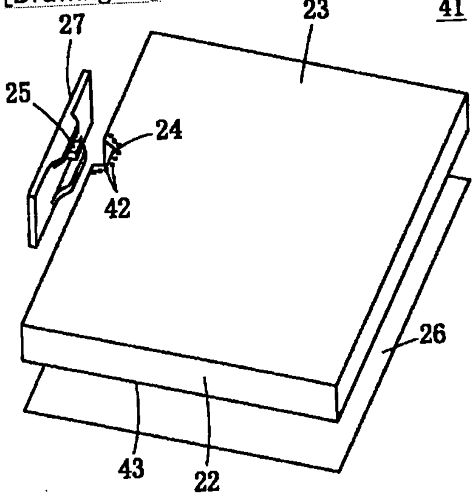
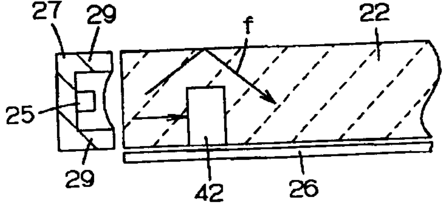


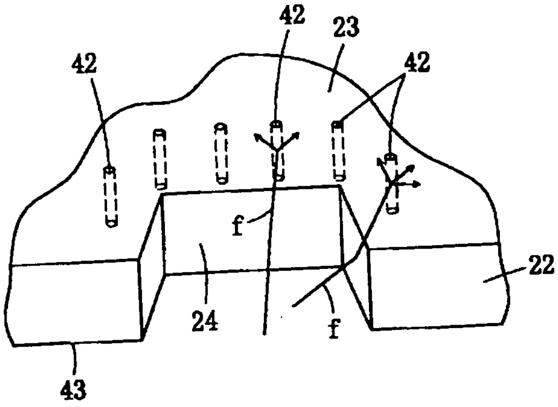
[Drawing 28]



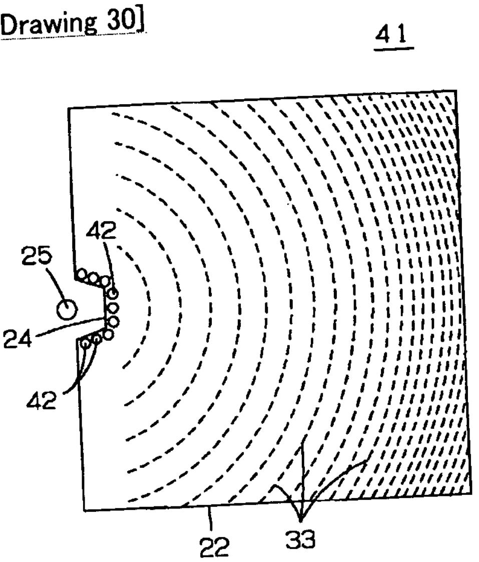
[Drawing 34]



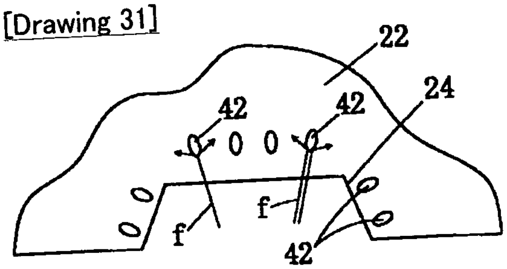
[Drawing 29]



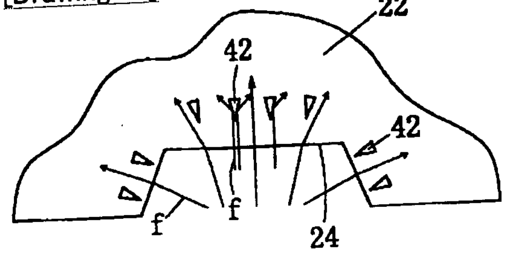
[Drawing 30]



[Drawing 31]



[Drawing 32]



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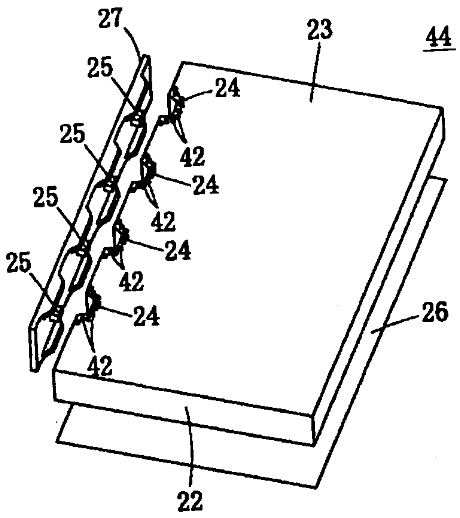

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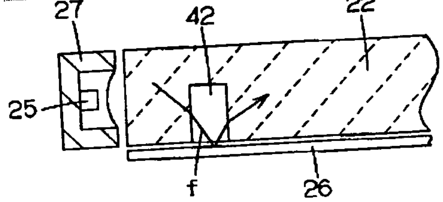
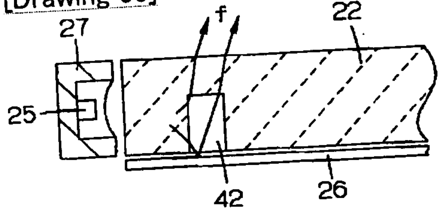
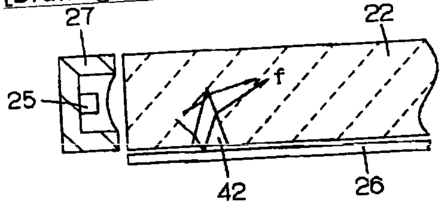


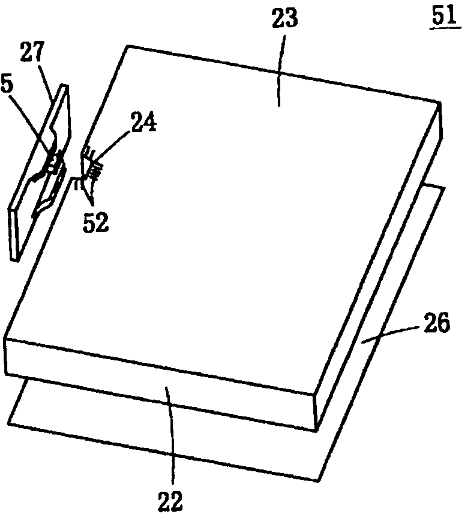
[Drawing 36]



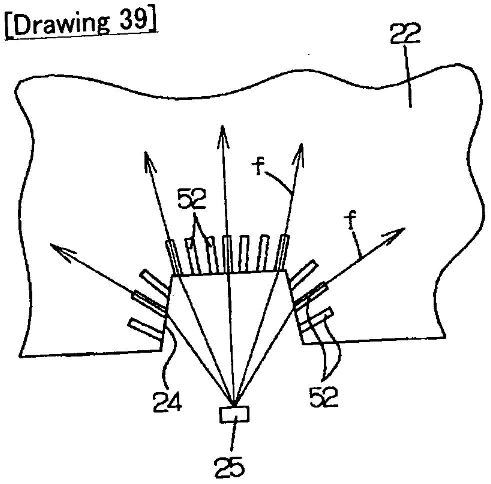
[Drawing 37]



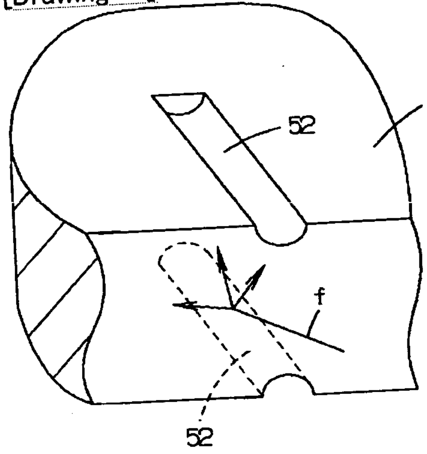
[Drawing 38]



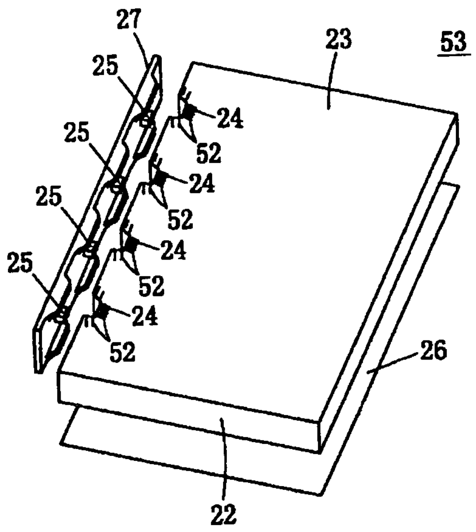
[Drawing 39]



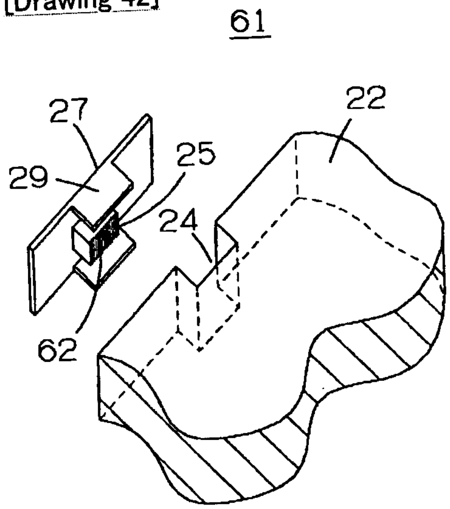
[Drawing 40]



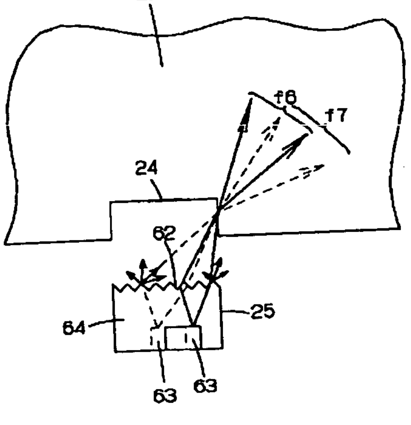
[Drawing 41]



[Drawing 42]



[Drawing 43]



[Translation done.]